WINZEN RESEARCH INC.
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POST FLIGHT REPORT - FLIGHT 749
Third Project MAN-HIGH ANIMAL FLIGHT FROM FLEMING FIELD, SOUTH ST.PAUL ON 14 APRIL 1957

Contract AF 29(600)-808

Report No. 1209-R

Prepared for: Aero-Medical Field Laboratory
Holloman Air Development Center
Holloman Air Force Base
New Mexico

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Approved and
Submitted by: O. C. Winzen

Date: 29 April 1957

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POST FLIGHT REPORT

FLIGHT 749

THIRD PROJECT MANHIGH ANIMAL FLIGHT

FROM FLEMING FIELD, SOUTH ST. PAUL ON 14 APRIL 1957

INTRODUCTION

The purpose of this report is to evaluate and describe Balloon Flight 749 which was launched from Fleming Field on 14 April 1957. This was the third animal flight of Project MANHIGH.

Flight 749 was a daylight animal flight, using the second intermediate MANHIGH capsule with an externally mounted air regeneration equipment to study daytime temperature balance and obtain parachute data.

In light of the experience gained from Flight 747, the decision was made to use the launch arm or SKYHOOK launch method. The launch arm method permitted a flight with less stringent weather requirements and less expense than the vertical launch method. Conditions were ideal the morning of the launch, resulting in a very successful flight.

II. PURPOSE OF FLIGHT

A. To study air conditioning equipment in the capsule in a daylight flight, specifically to study temperature balanc and obtain design data on the following:

1. Efficiency of the new outboard water cooler.
2. Efficiency of the air regeneration unit mounted outboard.
3. Operation of the oxygen converter.
4. Heat flow through double windows.
5. The data pertaining to climate control

B. To obtain data on the performance of the gondola recover parachute system when released at high altitude.

1. Parachute action film taken at 64 fps for slow motio projection showing the opening of the parachute cano
2. Stability of the gondola during descent taken at 40 f with a horizon camera.

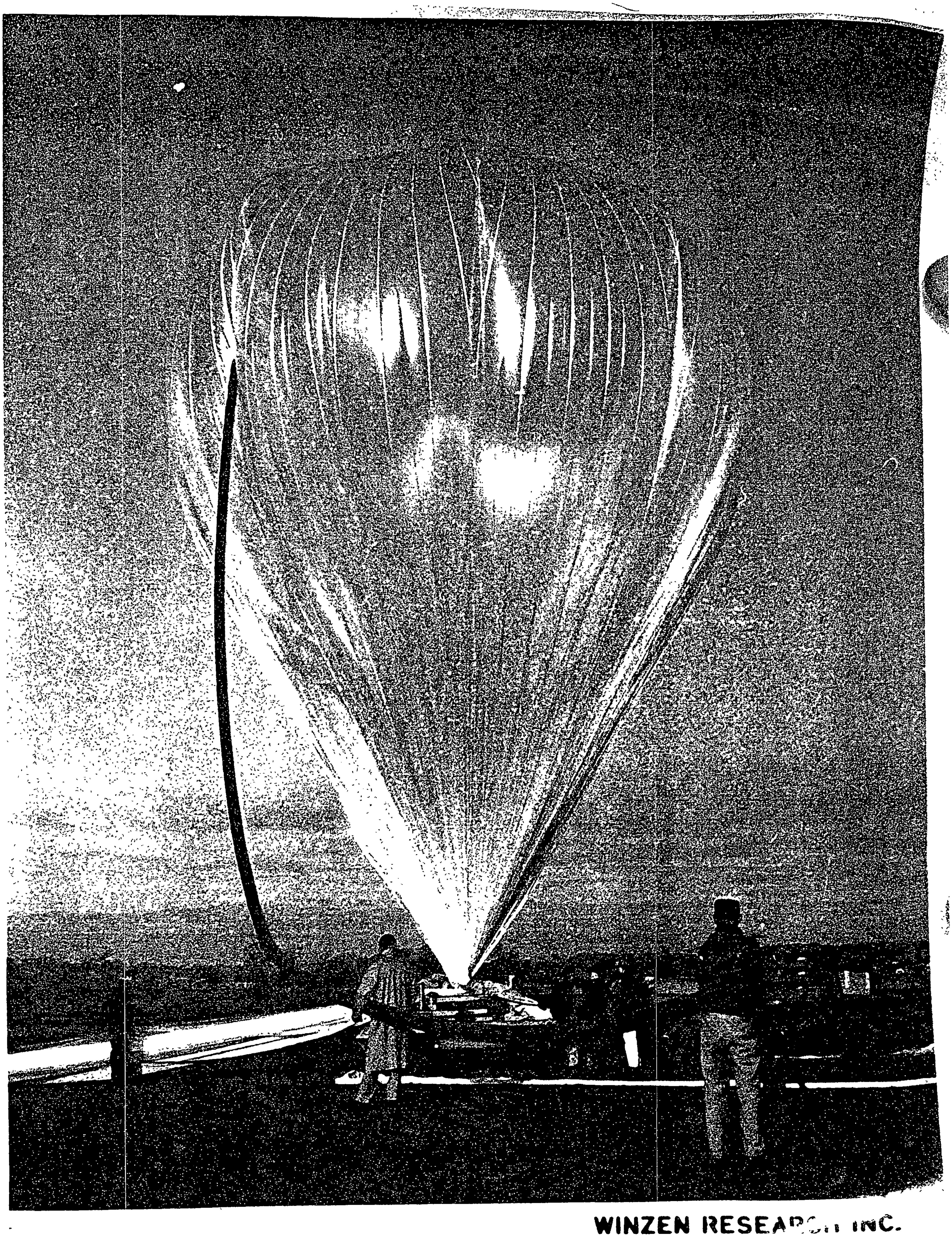
In addition to the above major objectives, there were a number of other investigations:

1. To obtain design data based on the performance of the 3 million cubic foot balloon.
2. To study capsule stability at altitude by photographi means (lapse rate movie of balloon and parachute taken from capsule at speed of 12 fpm).
3. To obtain cosmic ray data for the test animals and various hitch-hike loads carried for contributing scientists.

III. DESCRIPTION OF FLIGHT

Air Force personnel worked through the night to prepare the animals, which were delivered to the WRI plant shortly after midnight. Company personnel then took over the installation of the cages and preparation of the capsule, and a pressure check was conducted at 0330 CST. The new external air regeneration unit permitted access to the water cooler after the capsule was sealed. This enabled the use of dry ice in the water supply in order to assure adequate temperature control on the ground. The capsule arrived at Fleming Field at approximately 0430 CST.

O. C. Winzen directed the launching, assisted by E. F. Lewis, Flight Chief. Conditions appeared to be ideal, and the launching progressed smoothly. The wind was from the North at 5 mph with a clear sky. Photos 749-8, 749-11, 749-41 and 749-43 show the launching operations - rigging the load line, etc. Photo 749-11 is of particular interest as it shows clearly the transition of the ducts to the balloon. A new method was worked out to synchro camera operations with the launching time. The Air Force C-47 took to the air and commenced orbiting over the bubble, Photos 749-8 and 749-11, approximately thirty minutes prior to actual launch time. Communications were maintained between the C-47 and the launch site by use of a portable VHF transceiver located at the launching platform. Prior to the launching the C-47 [illegible] worked out the proper orbit to assure photographic coverage [illegible] the launching and had clocked the time involved for making [illegible] course. Thus, when the launch was about to take place, [illegible] was notified of this and they, in turn, started a count [illegible] giving us a thirty second warning and [illegible]



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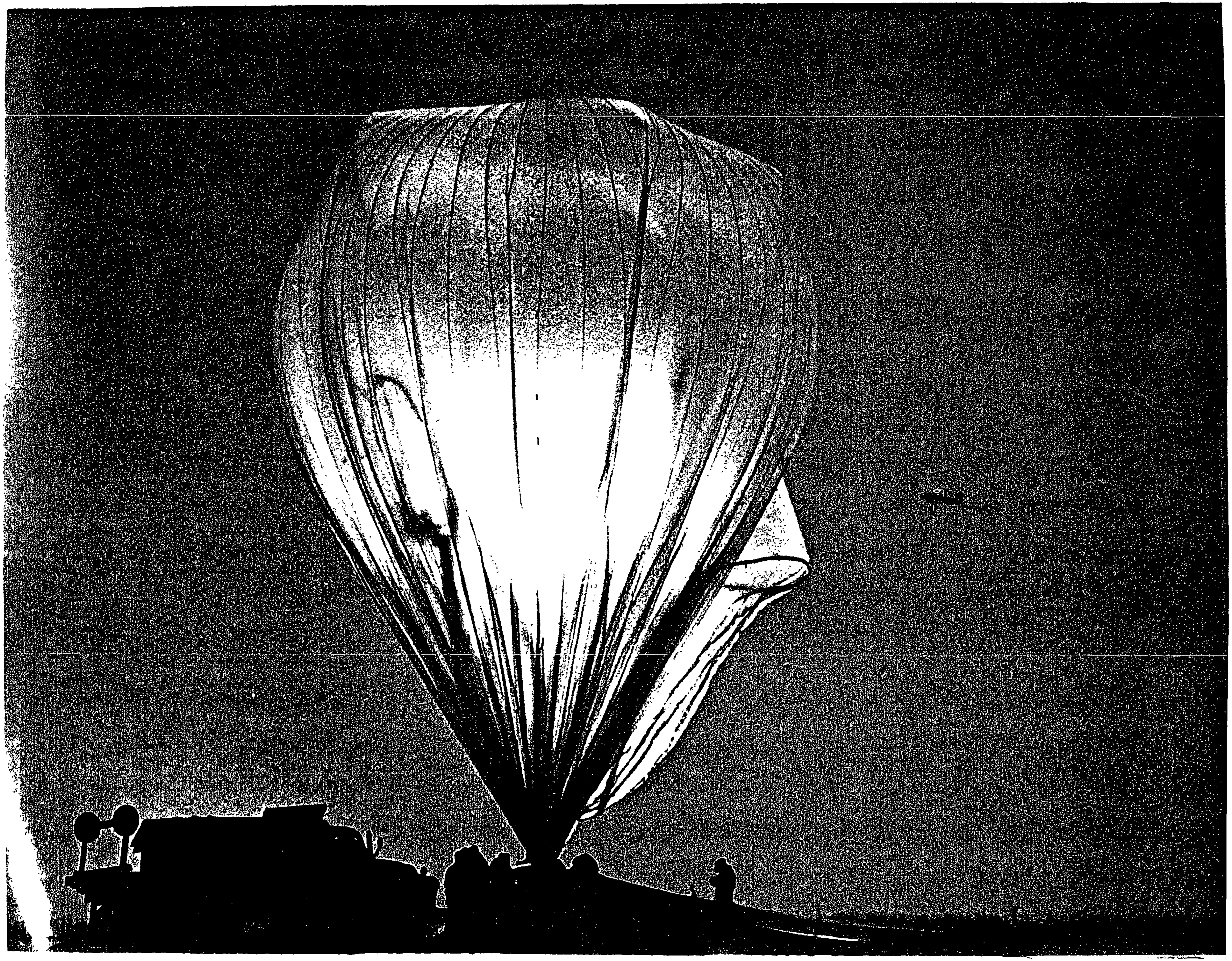
FLIGHT 749 · S



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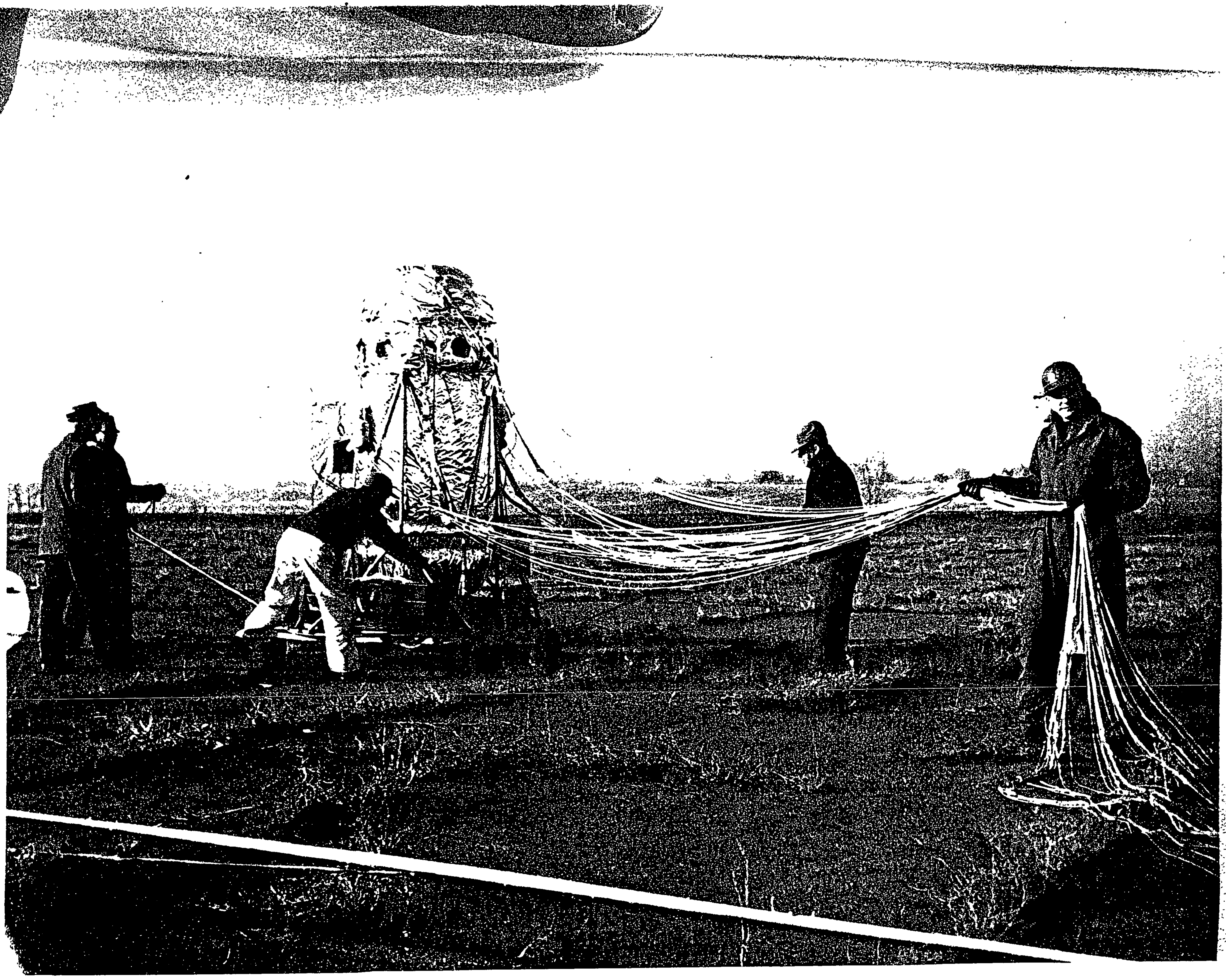
FLIGHT 749·1



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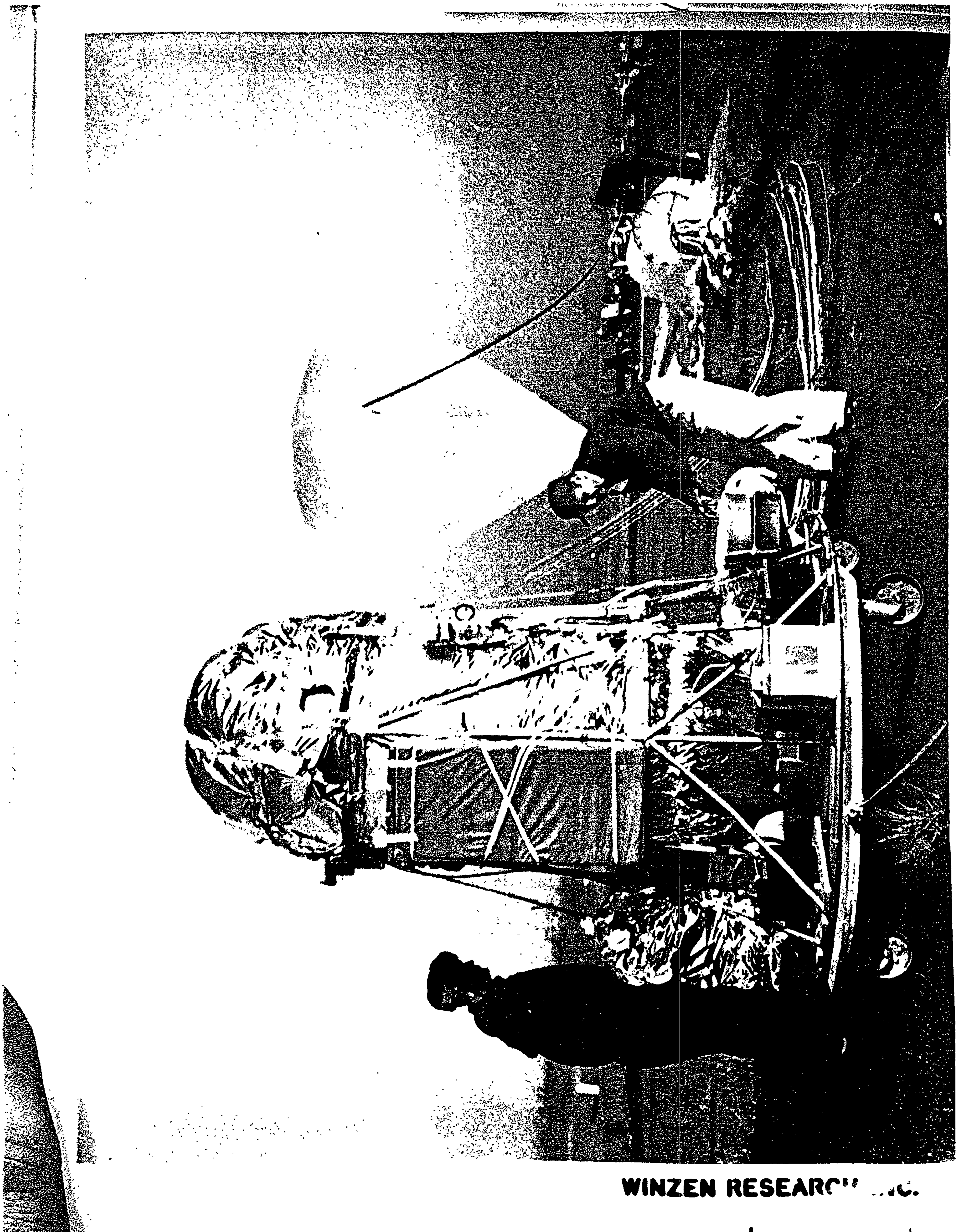
FLIGHT 749.4



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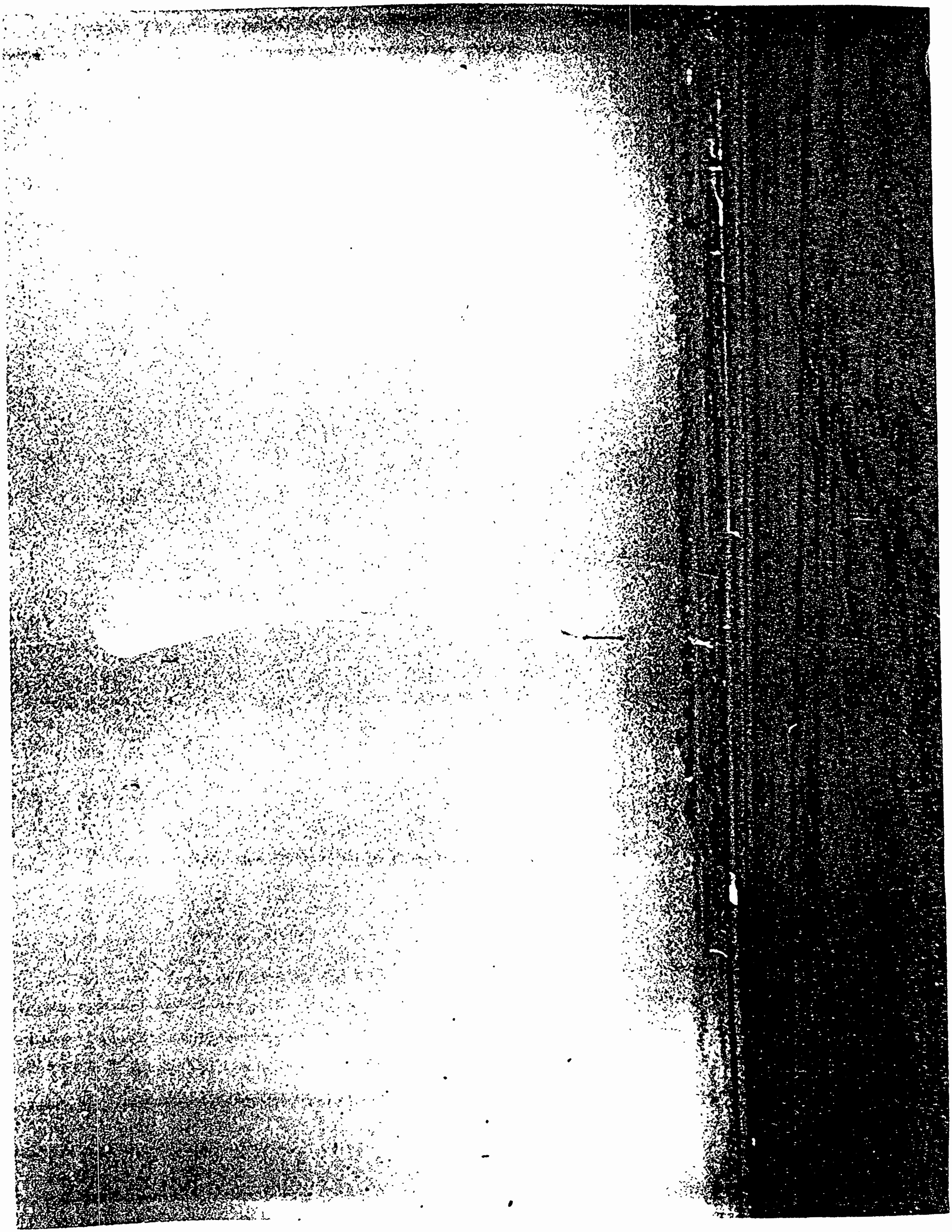
FLIGHT 7 4 9 - 4 1

and calling the release time. It was understood, of course, that if the wind conditions were not satisfactory the launch would be postponed until they could make another run. Synchronized with their operation, Major Simons fired a flare gun at the thirty and fifteen second warnings to alert the outlying camera positions. As it turned out, the balloon was launched on the first count down at 0718 CST.

The gondola had been located on a castered launching cart an this launching cart had been correctly positioned in the estimate take-off point of the capsule. The balloon picked up the load s gently that a slight bind between the gondola undercarriage and the positioning cleats on the top of the launching cart was enoug to hold the gondola to the cart. When the gondola was lifted fr the balloon proceeded gently on its way. (See Photo 749-44 and 749-45).

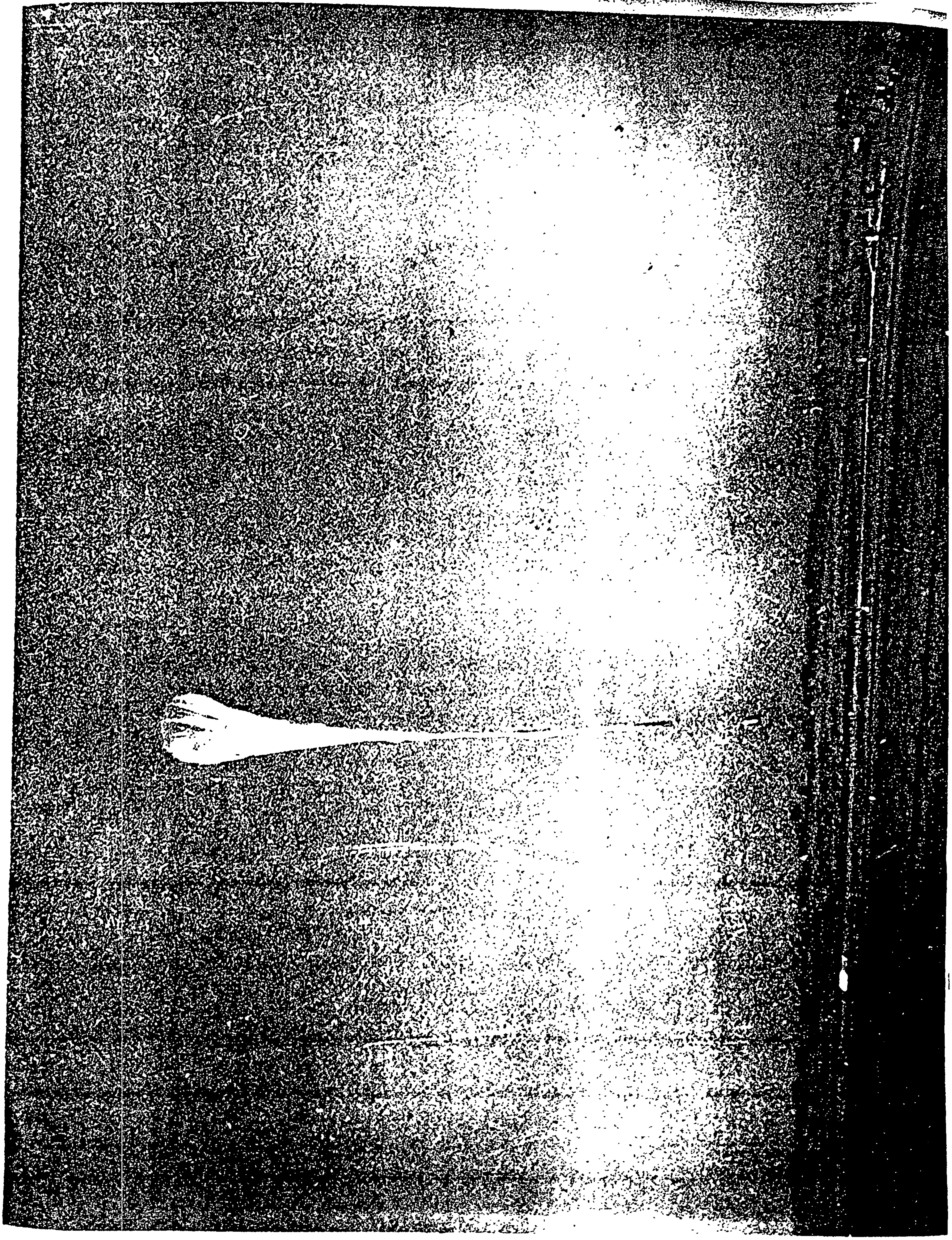
A slight helium shortage necessitated the removal of all of the ballast plus the instrument package which would photographically record altitude and time as a back-up for the telemetered information. This was a very unfortunate turn of events, as the provisions for trapping the animal urine were not satisfactory, and the telemetered altitude information was lost for much of the flight because of short-circuits in the equipment.

After the launch, the Air Force C-47 landed to pick up the rest of the tracking crew. The Navion with the WRI crew, which was already airborne, took up the job of tracking the balloon to ceiling. The balloon trajectory is shown on Drawing [illegible]



WINZEN RESEARCH

FLIGHT 749.44



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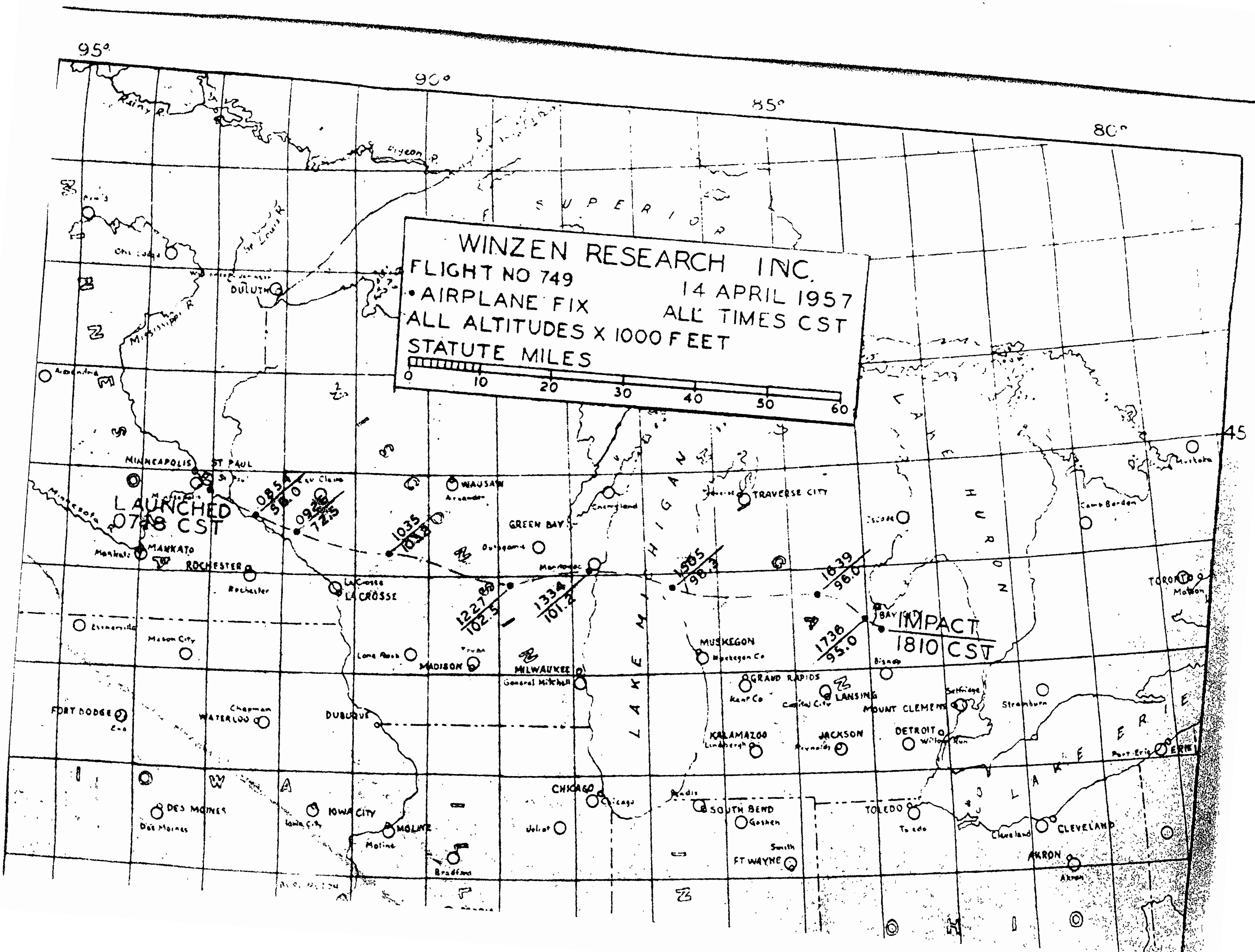
FLIGHT [illegible].45


WINZEN RESEARCH INC.
FLIGHT NO 749
14 APRIL 1957
• AIRPLANE FIX
ALL TIMES CST
ALL ALTITUDES X 1000 FEET
STATUTE MILES
0
10
20
30
40
50
60
95°
90°
85°
80°
45
LAUNCHED
0748 CST
0854
96.0
0926
72.5
1035
1227
102.5
1334
101.2
1505
98.3
1639
96.0
1736
95.0
IMPACT
1810 CST
MINNEAPOLIS
ST PAUL
MANKATO
ROCHESTER
LA CROSSE
WAUSAU
GREEN BAY
MADISON
MILWAUKEE
TRAVERSE CITY
MUSKEGON
GRAND RAPIDS
LANSING
MOUNT CLEMENS
DETROIT
JACKSON
KALAMAZOO
SOUTH BEND
FT WAYNE
TOLEDO
CLEVELAND
AKRON
CHICAGO
DUBUQUE
MOLINE
IOWA CITY
DES MOINES
WATERLOO
FORT DODGE
DULUTH
TORONTO
BAY CITY
ERIE
SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE
IOWA
Rainy R.
Pigeon R.
Mississippi R.
St Louis R.
Minnesota R.

The Navion was joined by the Air Force C-47 at approximately 0830 CST. Communications between the C-47, the Navion and WRI plant were well coordinated and very satisfactory. The plane to plane communications on the VHF channels were handled by Captain Kittinger in the C-47, and the three and six megacycle communications between planes and the WRI plant were handled by K. E. Bower of Winzen Research Inc. By using split earphones, Mr. Bower was able to monitor the communications channel and the balloon beacon signal simultaneously. The receiver used for the beacon signal was independent of the C-47 communications system and thereby free of interference from the operation thereof. By having a definite understanding as to assignments of duties, there were no misunderstandings or unnecessary interruptions. It should be added, that the morale of the tracking crew aboard the C-47 was high and contributed a great deal to the success of the mission.

Throughout the flight, observers were stationed in the C-47 blisters, continuously monitoring the balloon. This was done by relay so that no one became excessively fatigued. Although it was necessary to monitor the balloon signal continuously during the flight, most of the time there was no information coming through, which made this job somewhat lighter than expected. Accurate fixes on the balloon were made at LaCrosse, Wisconsin, using the Weather Bureau theodolite which was already oriented. This was accomplished during the time the C-47 was taking on gas. The flight, up to this point, went exactly as planned. At this time, the Navion also landed at LaCrosse to take on fuel.

A phone call made from LaCrosse to the WRI plant revealed that the telemetering equipment was beginning to function sporadically, and as soon as an engine could be started, monitoring of the balloon beacon was resumed again while on the ground. From this time on, the beacon trouble occasionally cleared, and we were able to gain some information concerning the altitude of the balloon, inside capsule pressure, and inside capsule temperature, the balloon at this time was at ceiling altitude 103,500 feet. By 1130 CST, both the aircraft were airborne again and the balloon was approaching Manitowac, Wisconsin on a heading which would take it across Lake Michigan. Later in the afternoon, approximately 1330 CST, as the balloon was beginning its trip across Lake Michigan, it became necessary to make a command decision. At that time the balloon was gradually losing altitude, with the capsule pressure dropping and the temperature rising. The question of whether or not to terminate the flight immediately or follow it across the lake and have the Navion follow around the lake was discussed by Mr. Winzen at the plant and Major Simons in the C-47 by means of radio communications. Mr. Winzen suggested that the aircraft make the decision as to what to do.

At this point the problem was discussed between the Navion, Captain Kittinger, Mrs. Winzen and Major Simons. It was felt that a significant part of the information concerning capsule temperature and pressure control would be lost if the flight were terminated immediately. The decision concerning the Navion was influenced by the prediction of nearly completely overcast conditions on the other side of the lake, as was also the case where we were. The Navion crew advised that they could get to the expected balloon position in time for cut-down, based on the then current balloon trajectory. The process of making this decision was a bit slow, but solidly arrived at, and seems to have met with the satisfaction of everyone concerned. The Navion was sent around to intercept the balloon for recovery.

A fix on the balloon as it was starting to cross the lake showed that it had assumed a much more northerly trajectory and had slowed down to around ten miles per hour. By the time the Air Force C-47 had landed on the other side of the nearly cloud-free lake at Ludington, Michigan, the balloon was nearly overhead, traveling between 52 to 55 miles per hour again. The theodolite was set up and two readings taken before the aircraft took off after the balloon. Calculations of the balloon trajectory indicated that twenty minutes would be available for cut-down attempts after the Navion would reach the expected balloon position and before the load would land in Saginaw Bay. It was decided to wait until the Navion was within range before attempting to cut-down the balloon. Repeated cutdown attempts at that time were futile, both on the part of the C-47 and the Navion. At this time, however, the beacon signal was on continuously again due to shorting of the keying circuit, and it was impossible to determine whether the radio control was functioning properly or not. Under normal operation, coded signals would be received on the beacon transmitter to indicate the channel of operations selected by the radio control circuit. Thus, when radio control cutdown was attempted, it was a moreorless blind attempt at control. A watch was used and a timing method developed which it was hoped would succeed in correct operation of the radio control. Since the radio control for the capsule separation could accidentally be triggered by this method, further attempts at cut-down were abandoned.

While waiting for the clock timer cut-down, Captain Kittinger and Lieutenant Bruce Kramer were pilots, Sergeant Dittmer was in the front blister, Major Simons monitored the signal and liaison communications. There is considerably more room to move around the primary observer, in this case Mrs. Winzen, at the back blister. Only one person can use the front blister.

At 1536 CST the timer cut the load loose, at which time the balloon had an elevation angle of approximately 80° from the C-47 with the sun behind us. The balloon did not appear to destroy for approximately ten seconds, during which time the pink parachute was clearly visible in sharp contrast with the large white balloon. The parachute became visible immediately and showed no change in appearance, size or brilliance during the next minute or two. From then on it gradually became larger and more easily visible as it descended. When the balloon collapsed after about ten seconds, it began to form a trail that at first looked like smoke, but on second thought must have been a trail of finely divided bits of polyethylene. The trail must have been nearly 10,000 feet long, considering the original balloon size. After approximately a minute of this, the balloon passed the parachute, since it was descending more rapidly, although by this time the white blob representing the remaining balloon was not much larger than the parachute in appearance. The aircraft pilot carefully avoided getting the parachute against the sun guided by the recommendation from the observers. As the parachute passed the aircraft altitude Mrs. Winzen took the co-pilot position and Sgt. Hensley and Sgt. Abramowitz positioned themselves at the back of the C-47, removing the jump door in order to take photographs directly out of the open door. The aircraft then followed the parachute and load to the ground. The sun set approximately fifteen minutes after the capsule had landed.

The load appeared quite stable on the parachute and was descending at approximately 32 feet per second (as determined by the pilot of the C-47). It descended into a suburban area of Saginaw, Photos 749-49 and 749-50, where it barely missed a house, Photo 749-51, as it landed in a backyard quite hard, appearing to have bounced about a foot off the ground, and immediately tipping over on landing. At this point, Captain Kittinger called the CAA asking them to relay the landing information to the state and city police to prevent unnecessary confusion and wild rumors concerning the package. The aircraft then flew over the landing area, dropping the note with a red drop streamer bag to request that the capsule be set upright and that the local residents notify the city police of the exact position of the capsule so that we could go directly to the package after landing the C-47. Immediately after landing, Major Simons requested the city police to post a guard to protect the capsule from souvenir hunters, which they agreed to do. The manager of the Tri-City Airport, whose name does not appear on our records, was most cooperative in guiding us to the impact site, at least five miles from the airport

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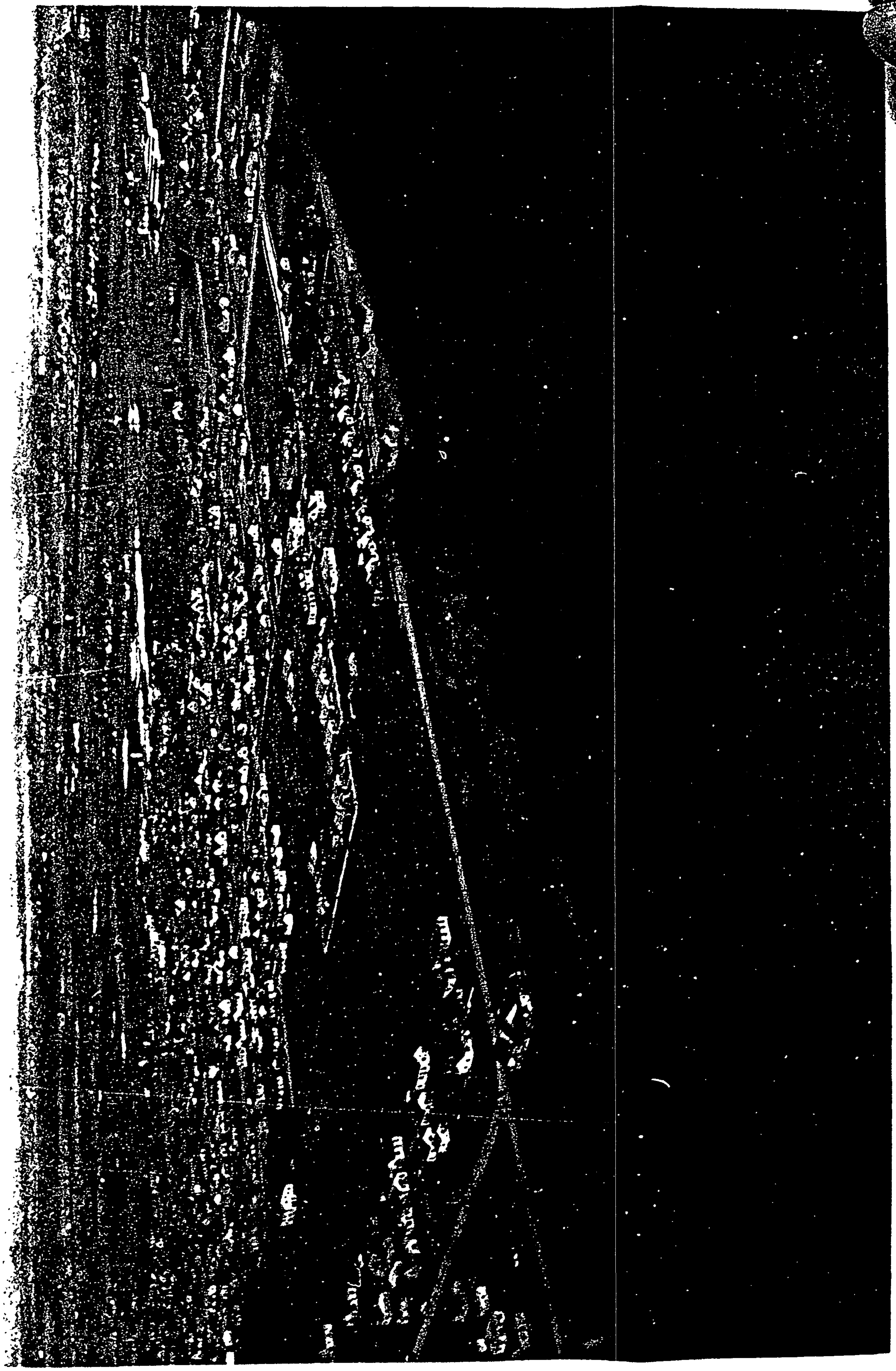
FLIGHT [illegible]



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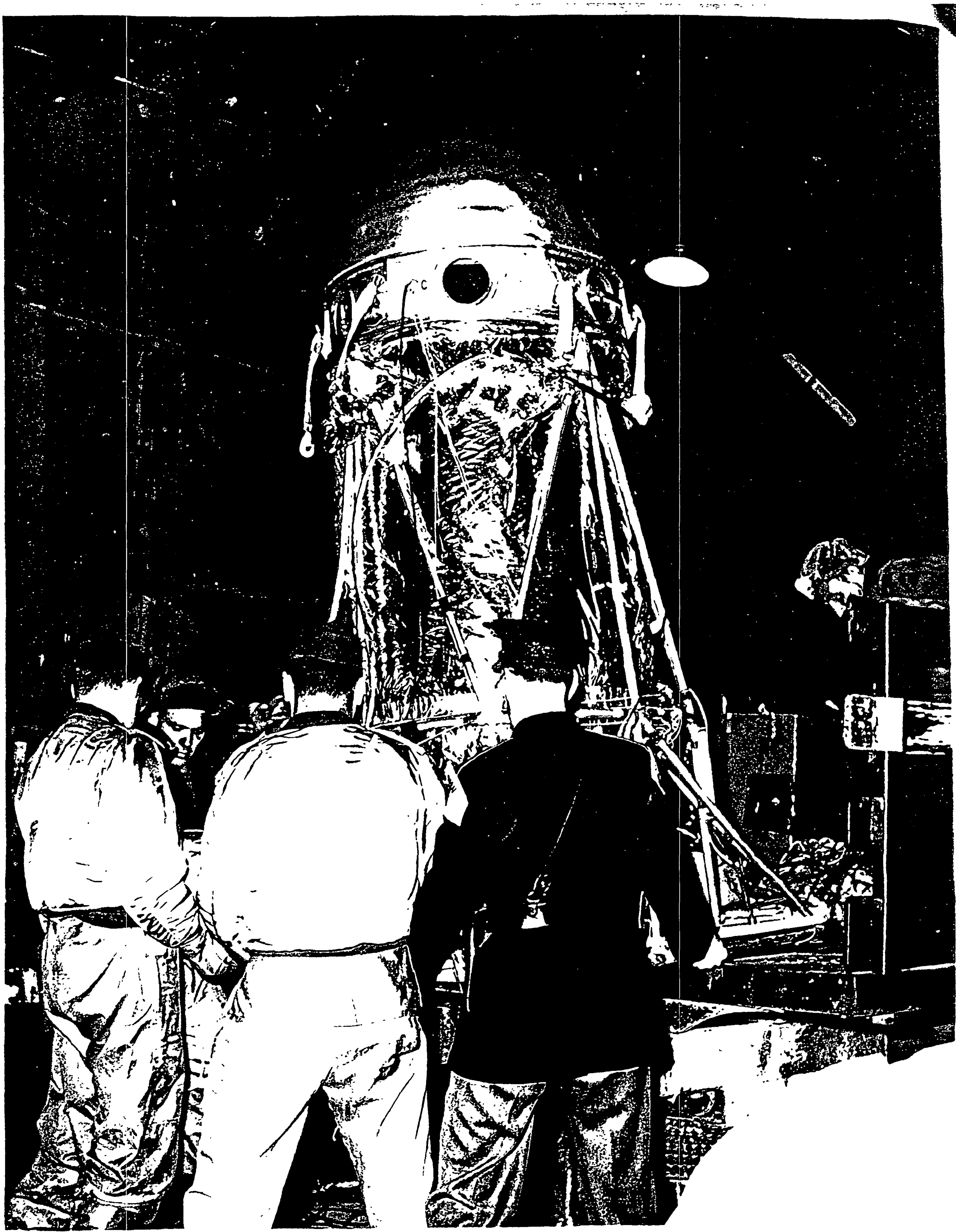
FLIGHT 749-50

through town. The capsule landed at approximately 1810 CST and the recovery crew arrived at the drop site around 1920 CST.

At the time of arrival, the temperature in the capsule was 84° on the thermometer placed by a window. A lead to the 24 volt battery had been torn loose on landing and the cooler blower was not operating. There was no apparent moisture in the capsule, on the walls or on the inside of the windows. The water cooler pans had about a quarter of an inch of ice frozen solid on the bottom of each four pans. It appeared as if the water had frozen during descent so hard that it still had not melted after an hour and ten minutes on the ground. The capsule was stripped of superficial attachments and loaded on a half-ton truck. Since the internal temperature was still 84° and the air cooler blower was no longer running, it was considered essential that the animals be given some air since their temperature would be at least ten degrees to fifteen degrees above that registered at the window. To this end the top hemisphere installation was removed and a half-inch bone knife blade inserted between the turret and bottom shell ring. The air temperature was approximately 40° F in Saginaw that evening. The return drive to the airport began and the animal capsule checked shortly before arriving at the airport to see how cold it was. The temperature then read 40°, and the top hemisphere felt quite cold to the hand. The capsule was closed and the trip to the disassembly point (a cool airport fire station) was expedited. In Photo W-2156 the load is seen being unloaded at the Saginaw airport. The capsule



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W-2154

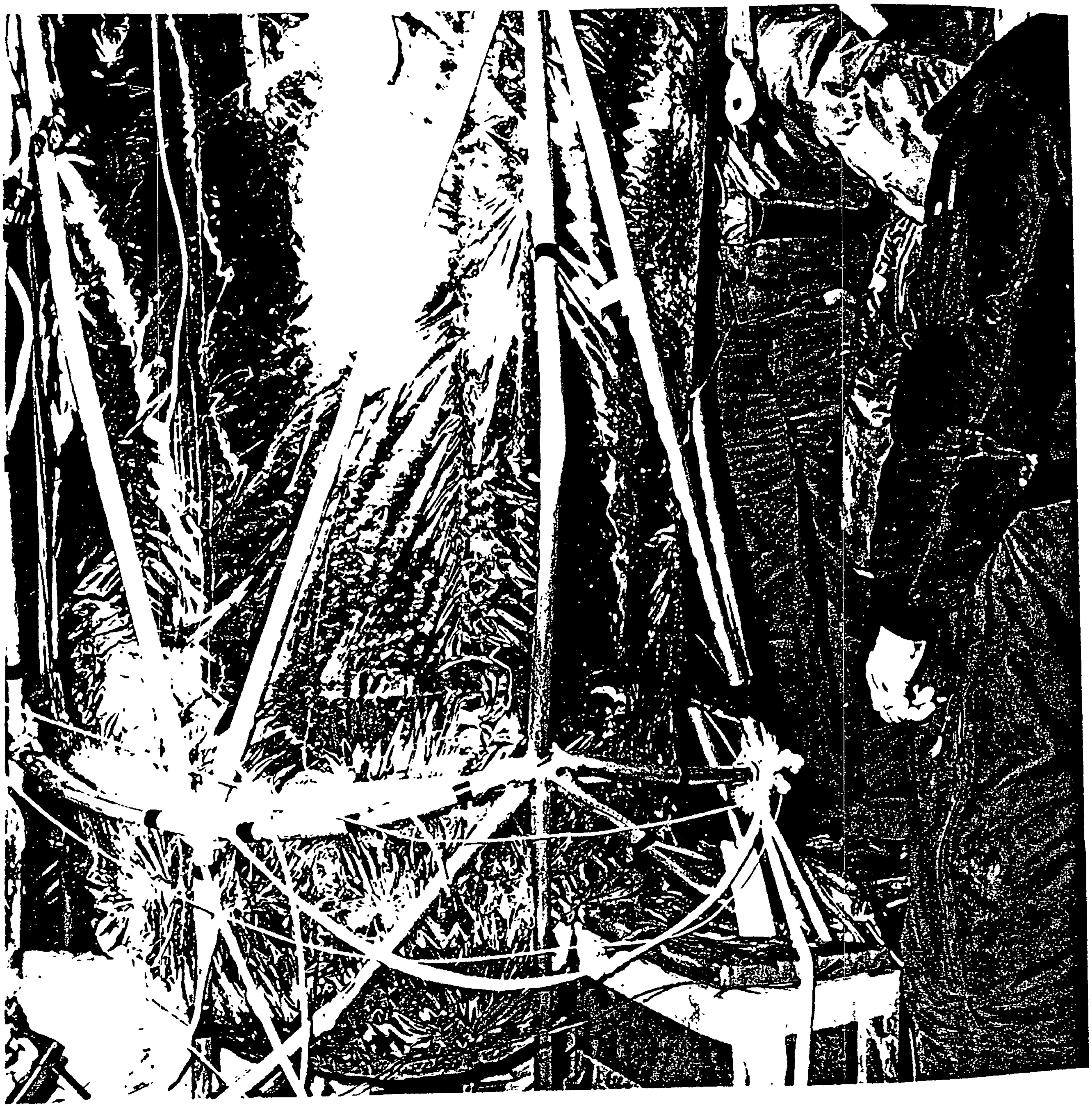
was opened approximately one hour after arrival. Upon oper the capsule, moisture was noted on the inside of the top he sphere and a dampness on the inside of the windows. This w almost certainly due to the lack of the blower inside, and cold night air cooling the walls of the capsule causing con sation.

All animals except a few mice and a monitored guinea pi were in apparently as good condition as when loaded in the capsule. They were dry and moderately warm. The condition the animals would indicate that neigher the carbon dioxide tension, oxygen partial pressure or temperature got beyond moderately stressful values.

The excellent condition of external equipment, including the external air regeneration system and water cooler, and t intact condition of all capsule contents, indicates that the landing gear operated most effectively, which was borne out its distorted condition, showing that it operated as intende (See Photos W-2151, W-2155 and W-2156).

Approximately four to five ounces of water remained in t water cooler sump. The amount of liquid oxygen remaining in the converter was undetermined.

Two officers of the Saginaw police department, officers and Miller, were the ones responsible for the good care take the capsule after landing, because they were the ones first arriving and then they requested the assistance of the Sagi Fire Department, which deserves a by-line of appreciation fo



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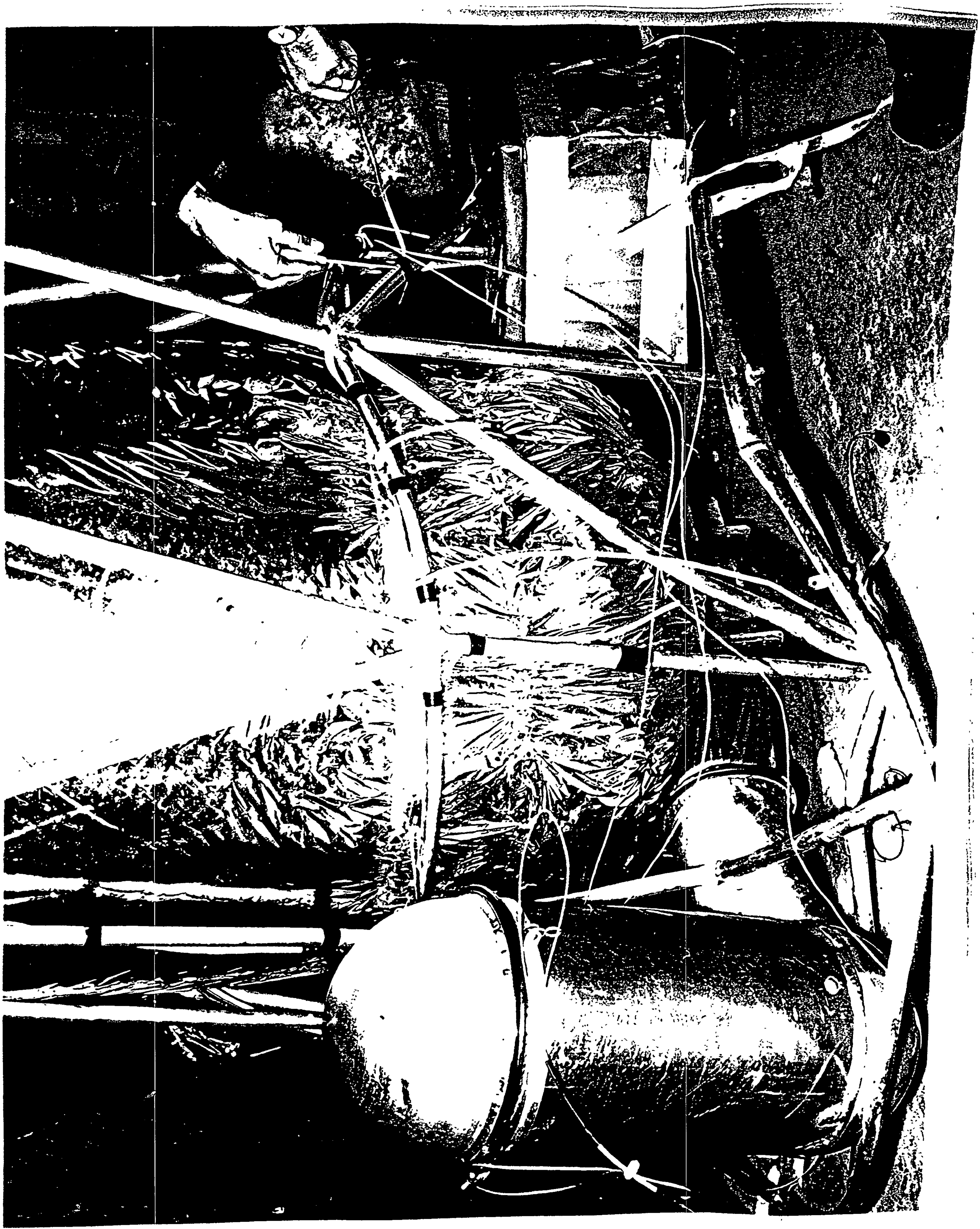
W-2151



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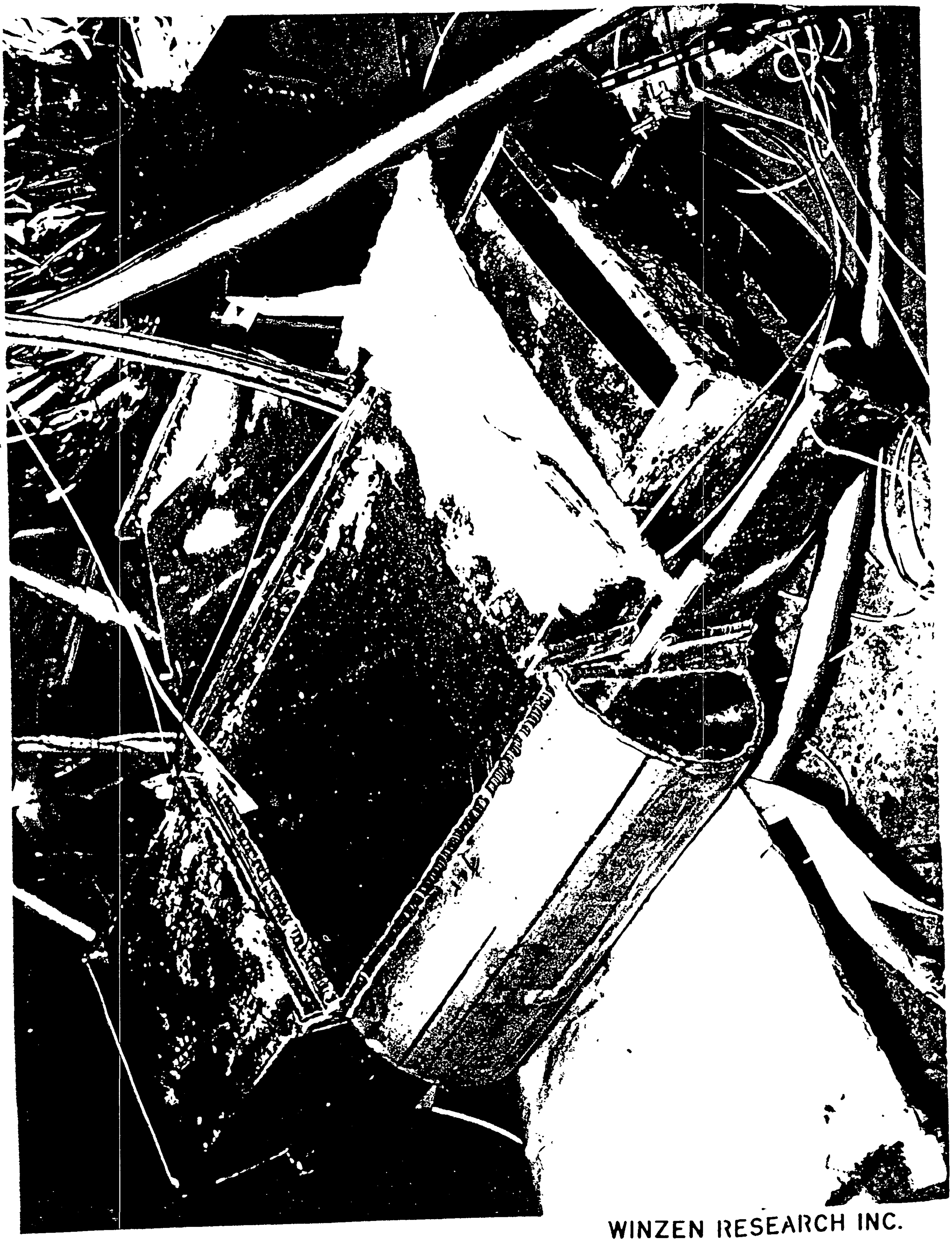
W-2155



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W-2156

their excellent cooperation and help in protecting the capsule from the curious. Sgt. Killingsworth of the Saginaw Police Department was the officer in charge when the recovery crew arrived, and he was most cooperative in helping with the recovery of the capsule.

The condition of the capsule undercarriage and the disassembly operation were photographically recorded by Mrs. Winzen and Sgt. Hensley. It was determined that the cameras photographing the balloon in flight and the parachute opening, had functioned properly and the film was removed therefrom. The disassembly operations were completed and the load stowed aboard the C-47 by 2330 CST. A stopover at the Ansco Developing Laboratories in Chicago was made enroute home to have the films of the balloon and parachute opening developed.

IV. INSTRUMENTATION

A. Balloon Controls

Provisions were made to drop ballast by means of radio control, however all ballast was removed prior to the actual flight. A back-up timer in addition to a radio control cut-down were provided as a means of terminating the flight.

B. Parachute Opening Shock With Time

The actual parachute opening was recorded by a motor driven camera operating at 60 frames per second, which was triggered three seconds before the load line of the balloon was cut. In two suspension lines there were Exline tensiometers for determining parachute opening shock with time. In another pair of suspension lines there were located Brinell tensiometers to determine maximum suspension shock. Located inside the gondola was a Cedar Engineering accelerometer, which put a signal on a "magic eye" tube, which was photographically recorded for a period of 80 seconds at 16 frames per second. The stability of the gondola and the parachute was recorded by a camera photographing the horizon at 40 frames per second commencing three seconds before the load was released.

C. Capsule Air Conditions

The following information related to gondola air conditions and gondola temperatures were to be telemetered in code groups and recorded at a ground receiving station;

1. The outside and inside temperatures of a double paned window and the inside temperature of a single paned window were to be measured by means of thermistors.
2. The outside air temperature was to be measured by a single thermistor suspended from the gondola.
3. The capsule air temperature was to be measured by means of the thermistor located as shown for the dry bulb on Drawing 383,312 in the air stream of the ventilator fan.
4. The relative humidity of the capsule atmosphere was to be obtained by use of the previous thermistor and a "wet" thermistor placed in this air stream.
5. A cooler coil and cooler air temperatures were to be measured by means of thermistors located as shown in Drawing 383,312.
6. The exhaust air temperature of the chemical tank was to be measured by means of a thermistor located as shown on Drawing 383,312.

D. Stability of Load Suspension

To determine this a camera was mounted in an instrument package on the side of the capsule to photograph the balloon at five second intervals during the first six hours of the balloon flight to study the rotation of the gondola relative to the balloon.

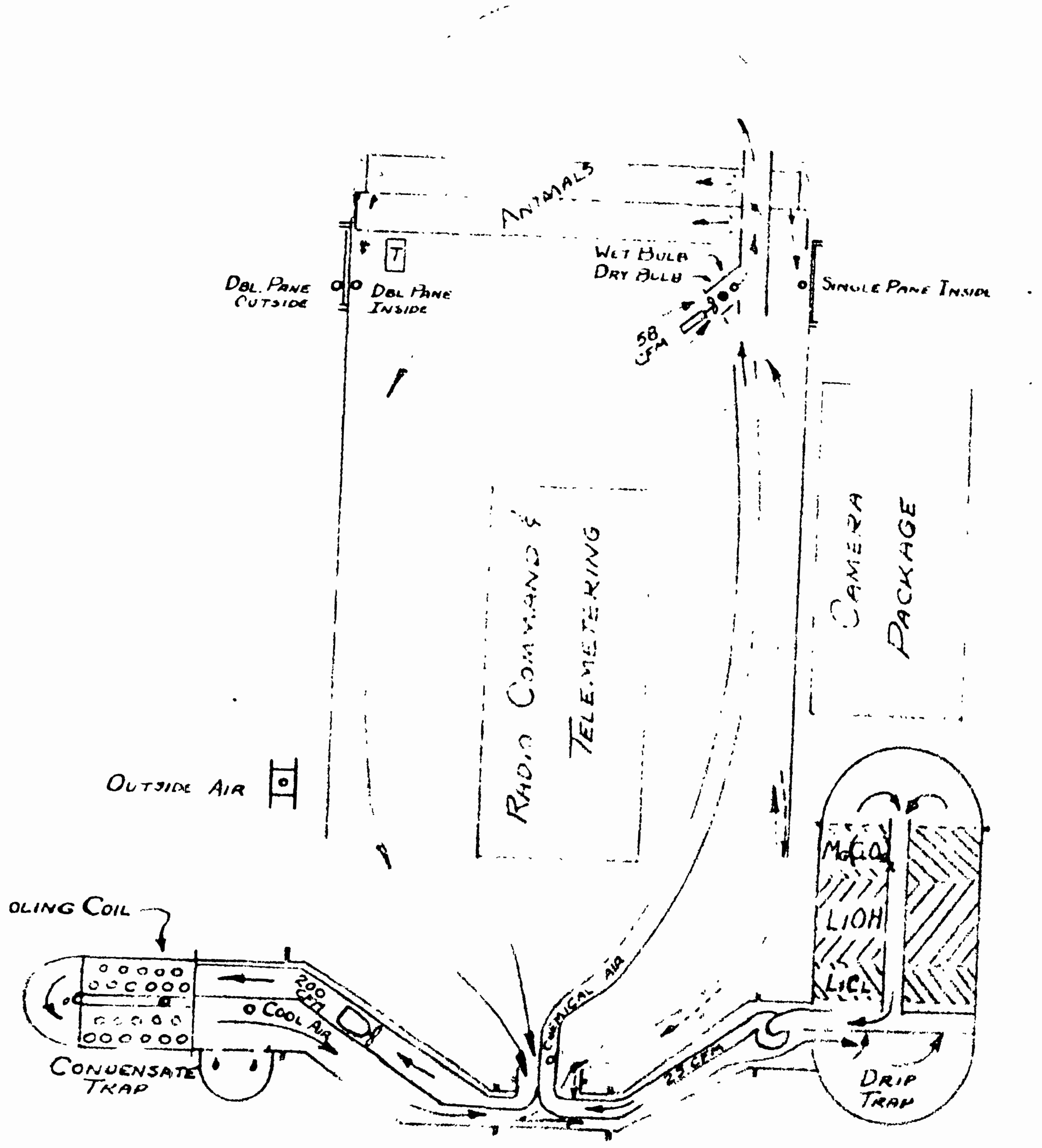
E. Cosmic Ray Effects on Animals and Allied Experiments

These experiments were supplied by Major Simons and were under his direction.

GEND

Thermistor
Air Flow
Thermostat

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL



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OFFICE & PLANT
8401 Lyndale So.
Minneapolis 20
FLIGHT CENTER
Fleming Field
So. St. Paul, Minn.

F. Oxygen Consumption

Oxygen partial pressure in the capsule atmosphere was measured by a 0 to 25 percent (at standard atmospheric pressure) Beckman oxygen analyser adjusted to cover an oxygen partial pressure range of 85mb to 335mb and photographed at five minute intervals. This meter was ventilated in between the time of taking pictures to obtain a new sample of air. The oxygen converter was weighed during the flight and its weight was recorded photographically also. The cooler fan off-on duty cycle was recorded during the flight on a smoked disc recorder.

G. Radio Control During Flight

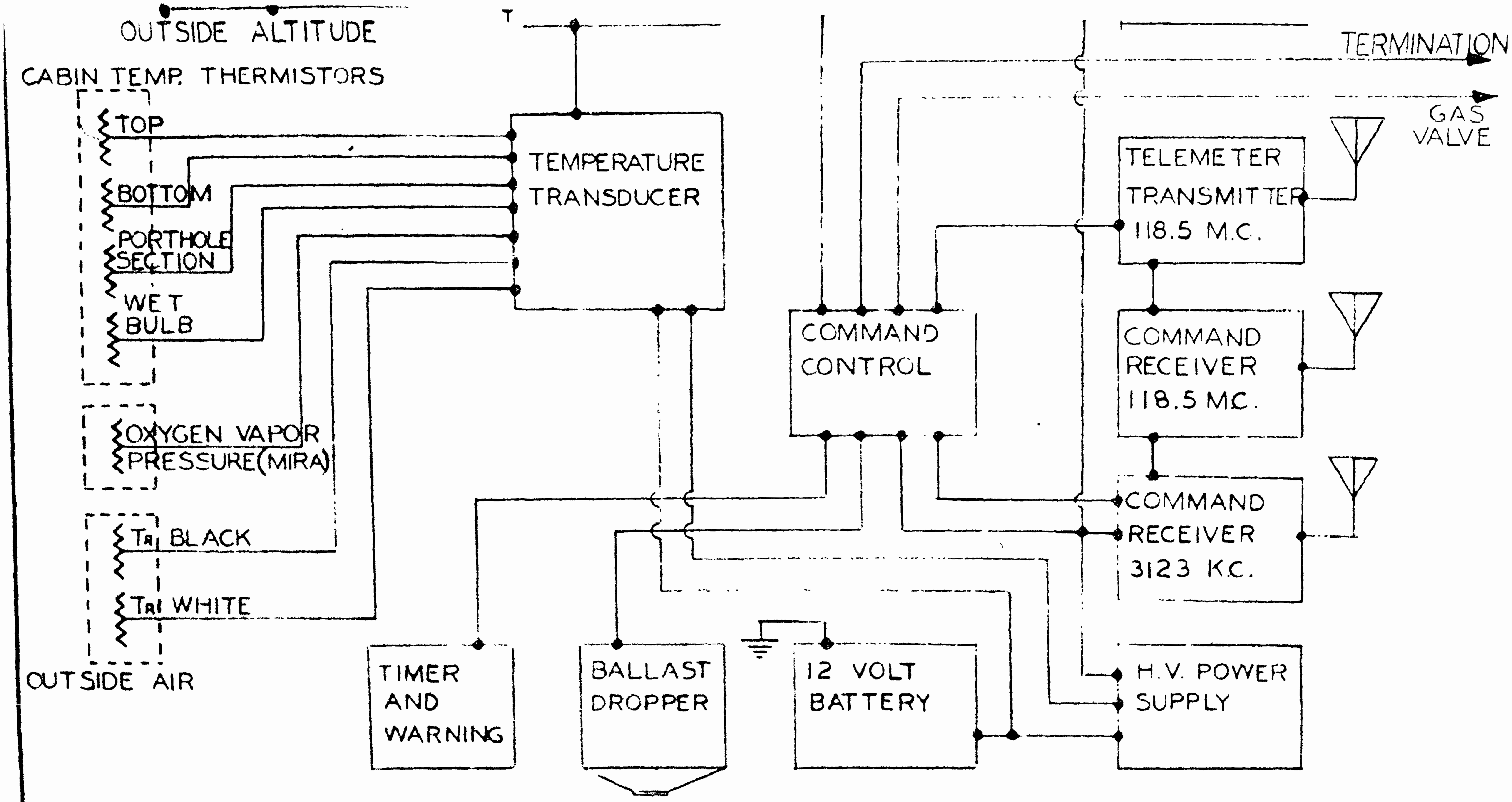
A radio control circuit, see Drawing W-1266-A, was furnished to perform the following functions during the animal flight:

1. Release ballast.
2. Separation of the load from the balloon.
3. Change the radio beacon from continuous operation to cycled operation in order to conserve battery.
4. Release of lower capsule shell to protect animals from high interior temperatures when on ground.

H. Communications and Telemetering Frequencies

Three frequencies for communications were available, 3123 KC, 6700.5 KC and 122.8 MC.

Normally the two tracking aircrafts stayed on 3123 KC and 122.8 MC. When the range from the plant was beyond about 125 miles, it became necessary to switch to 6700.5 KC for operation between planes and plant.



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MINNEAPOLIS 20, MINN
FLEMING FIELD SOUTH ST. PAUL, MINNESOTA

DR. BOONE	APP.	SCALE NONE	MAT.	NO. REQ.	NAME BLOCK DIAGRAM DAEDALUS ANIMAL GONDOLA	DRG. NO. W-1266-A
CH.	APP.	DATE 13 DEC 55	MATL. SPEC.			

Communications between the planes could be carried on on 122.8 MC. The main plant was operating simultaneously on 3123 and 6700.5 KC with no VHF equipment.

Radio control was initiated on 6700.5 KC or 118.5 MC. Telemetering transmitter frequency was 1638 KC.

V. ANALYSIS OF FLIGHT DATA

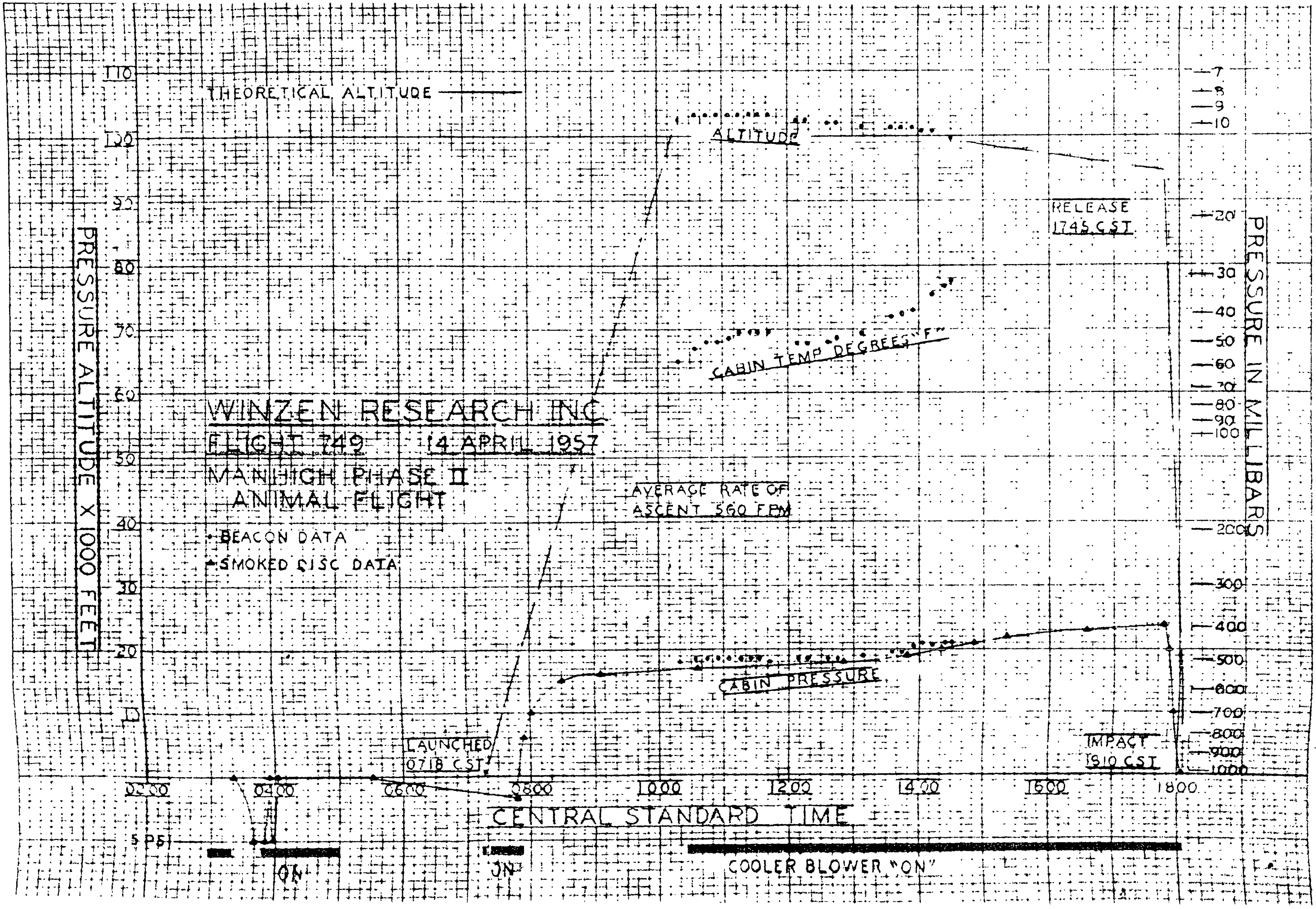
A. Time Altitude Curve

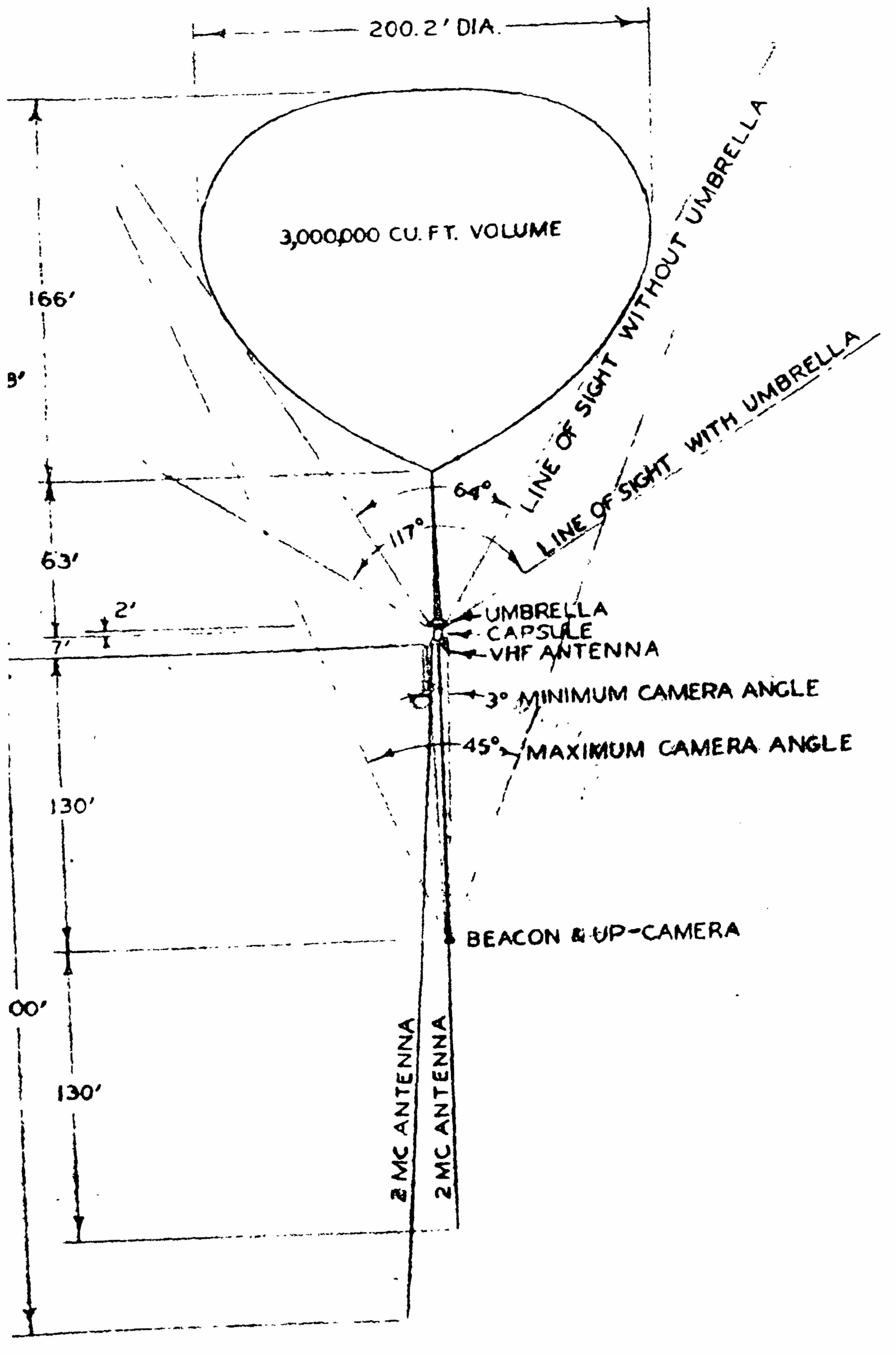
As explained previously in the description of the flight, the instrument package, which contained gauges, a clock and camera to record time and altitude, had to be removed from the gondola prior to the flight due to a shortage of helium. Therefore, the only altitude information available was that received intermittently from the telemetering equipment. Fortunately, one reading of altitude was received just prior to the balloon reaching ceiling; so, it is reasonable to assume that the time altitude curve would be as plotted on Drawing 383,315. The average rate of ascent according to this curve would have been 560 ft/min. Information concerning the free lift, and other launching information will be found in the balloon flight report which is attached.

B. Parachute Opening Shock

As will be seen from Drawing W-1622-A, an open parachute was flown with this load. This was a 40.4 foot diameter chute for which the calculated load versus rate of descent curve is shown on Drawing 383,302. We feel that very valuable information concerning opening shock of an open parachute rigging has been gained from this flight.

The actual parachute opening and load oscillation were recorded by two high speed cameras which were triggered three seconds prior to the release of the load. The camera which photographed the opening of


WINZEN RESEARCH INC
FLIGHT 749 14 APRIL 1957
MANHIGH PHASE II
ANIMAL FLIGHT
• BEACON DATA
• SMOKED DISC DATA
THEORETICAL ALTITUDE
ALTITUDE
CABIN TEMP DEGREES "F"
AVERAGE RATE OF ASCENT 560 FPM
CABIN PRESSURE
RELEASE 1745 CST
LAUNCHED 0718 CST
IMPACT 1810 CST
PRESSURE ALTITUDE X 1000 FEET
110
100
90
80
70
60
50
40
30
20
10
PRESSURE IN MILLIBARS
7
8
9
10
20
30
40
50
60
70
80
90
100
200
300
400
500
600
700
800
900
1000
0200
0400
0600
0800
1000
1200
1400
1600
1800
CENTRAL STANDARD TIME
5 PSI
ON
ON
COOLER BLOWER "ON"

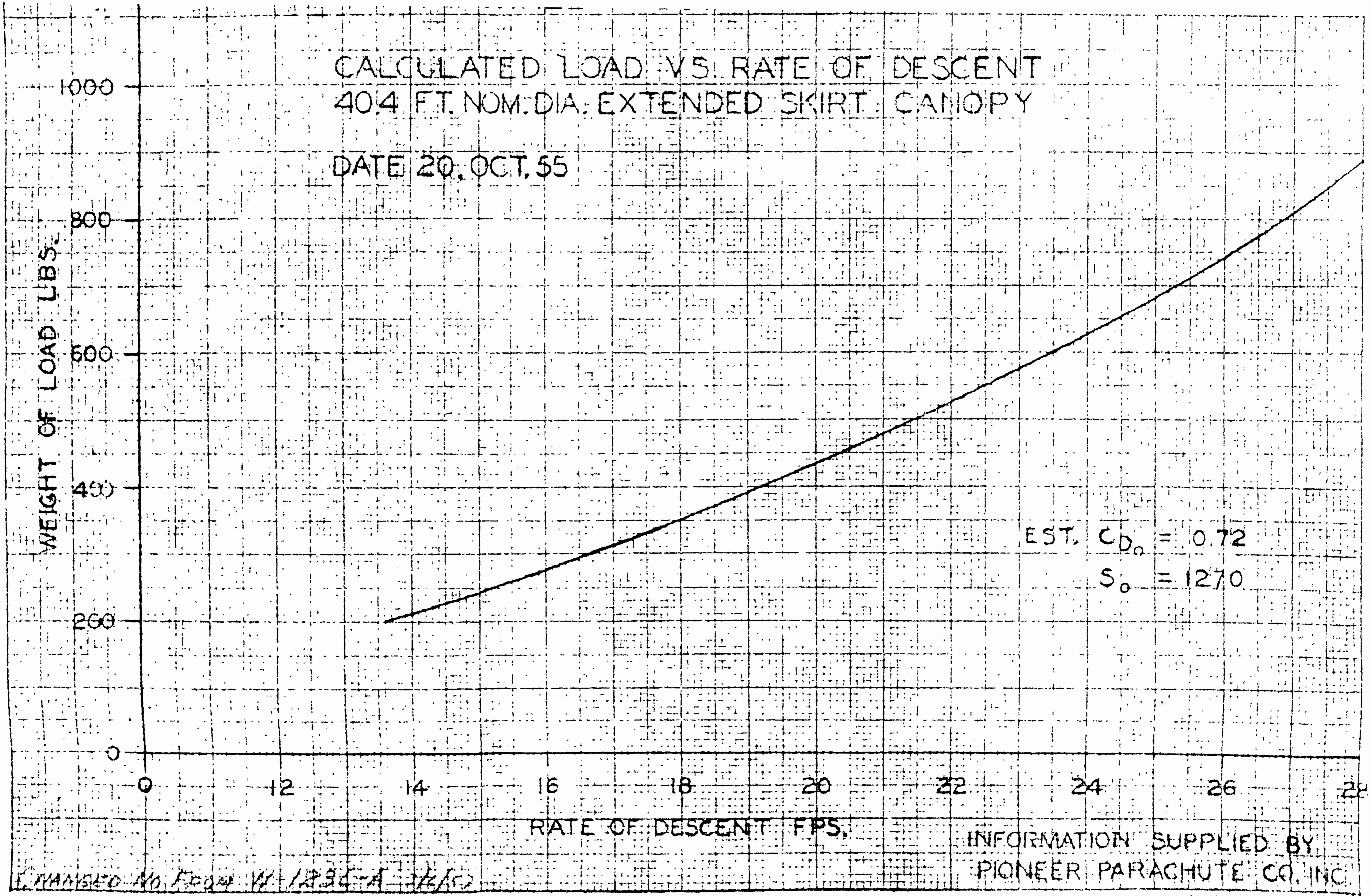


WINZEN RESEARCH INC.

MINNEAPOLIS 20 MINNESOTA

FLEMING FIELD SOUTH ST. PAUL, MINNESOTA

DRG. NO.	W-1622-A
NAME	PROPOSED LOAD SUSPENSION ANIMAL FLIGHT PROJ. MANHIGH
NO. REQ.	
MAT.	
MATL. SPEC.	
SCALE	1"=80'
DATE	22 OCT 56
DR.	BOONE
APP.	
CH.	
APP.	



CALCULATED LOAD VS. RATE OF DESCENT
40.4 FT. NOM. DIA. EXTENDED SKIRT CANOPY

DATE 20. OCT. 55

EST. $C_{D_o} = 0.72$
$S_o = 1270$

INFORMATION SUPPLIED BY
PIONEER PARACHUTE CO. INC.

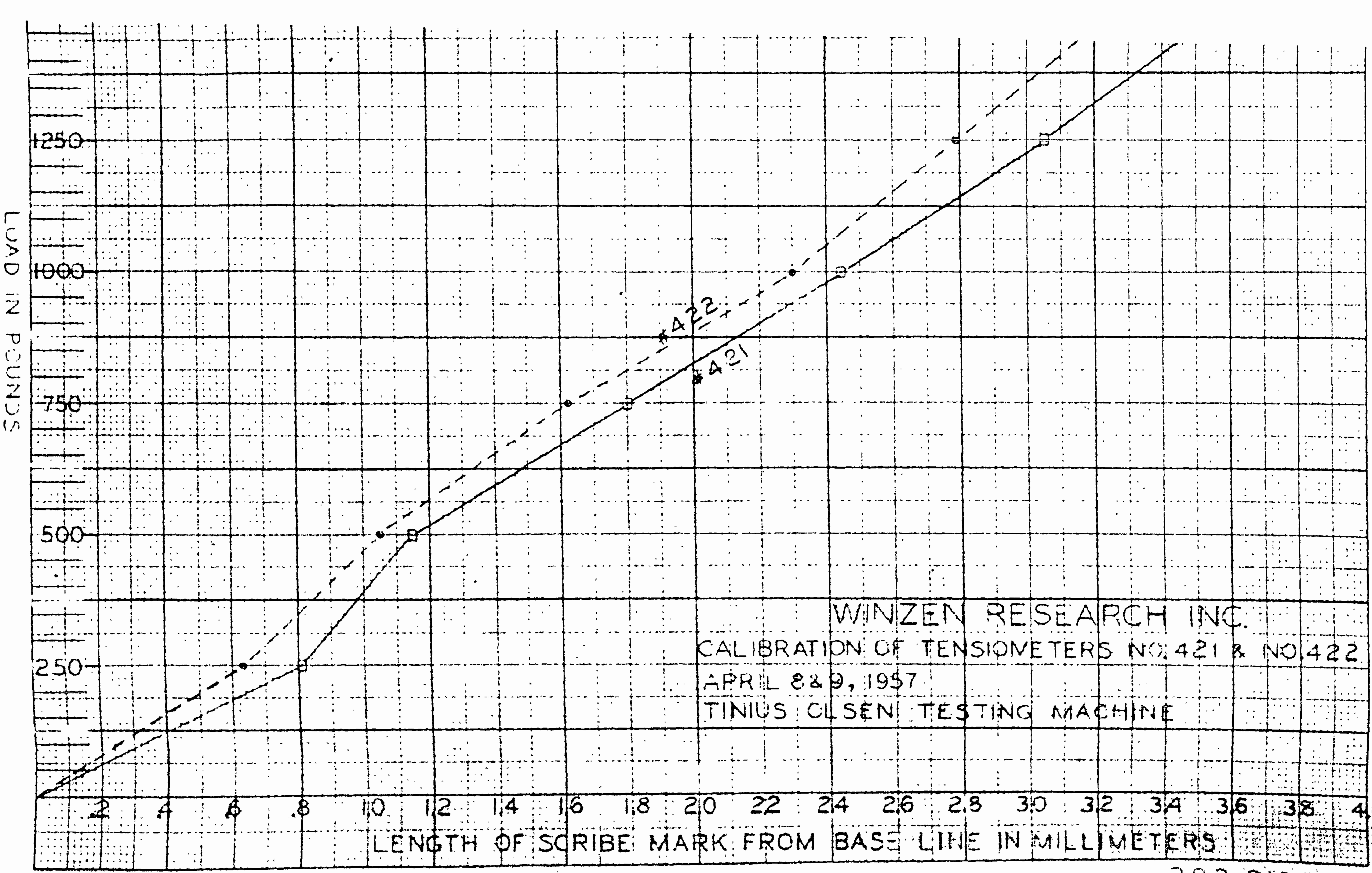
CHANGED No. FROM W-1295-A 12/57

393,302

the parachute was running at a speed of 60 frames per second and the camera which photographed the horizon for load oscillation was running at a speed of 40 frames per second. Both of these cameras contained 100 feet of 16mm Ansco daylight film.

The shock of the parachute opening was recorded by Exline and Brinell tensiometers installed in the parachute risers. These were backed up by a Cedar Engineering accelerometer which was installed on the bottom shelf of the telemetering equipment. A 6E5 electronic eye-tube was used to furnish the indication of acceleration which in turn recorded by an 8mm motion picture camera at 16 frames per second.

As will be seen from the "slow motion" pictures, the parachute opened within seconds of the release from the balloon. It will be noted that the shroud lines are quite slack initially and gradually take up tension. The parachute was visible to observers throughout the descent. The Exline tensiometers recorded the drag of the chute during the first ten seconds. Two Exline tensiometers were used installed in diametrically opposite shroud lines. The calibration curves for these instruments numbered 421 and 422 are shown on Drawing 383,310. The curves recorded on their aluminum foil drums, over a period of the first ten seconds, were of the same characteristics. Unit No. 421 started with a displacement of 0mm gradually building up to 0.225 mm at the end of ten seconds


WINZEN RESEARCH INC.

CALIBRATION OF TENSIOMETERS NO. 421 & NO. 422

APRIL 8 & 9, 1957

TINIUS OLSEN TESTING MACHINE

JRC NO. 383,310

[illegible] D-6445

ITY TESTING AND ENGINEERING LABORATORY, INC.

ENGINEERS AND CHEMISTS

2440 Franklin Avenue - St. Paul 14, Minn.

ORT OF: Measurements of Load Measuring Apparatus

DATE: April 26, 1957

Winzen Research
8401 Lyndale Avenue
Minneapolis, Minnesota

FURNISHED BY:

COPIES TO:

SAMPLE IDENTIFICATION:

Two brinell cubes
Two foil sheets

PROCEDURE:

A brinell scope was used to measure indentation on cubes. A metalloscope was used to measure scratch lines on the foil sheet.

RESULTS:

Brinell cubes - Flight #749
A. difficult to read - approximately .7 mm
B. .7 to .9 mm

Foil Sheet - Flight #749
#421 - .225 mm
#422 - .202 mm

REMARKS:

The above samples were submitted to this laboratory on April 22, 1957.

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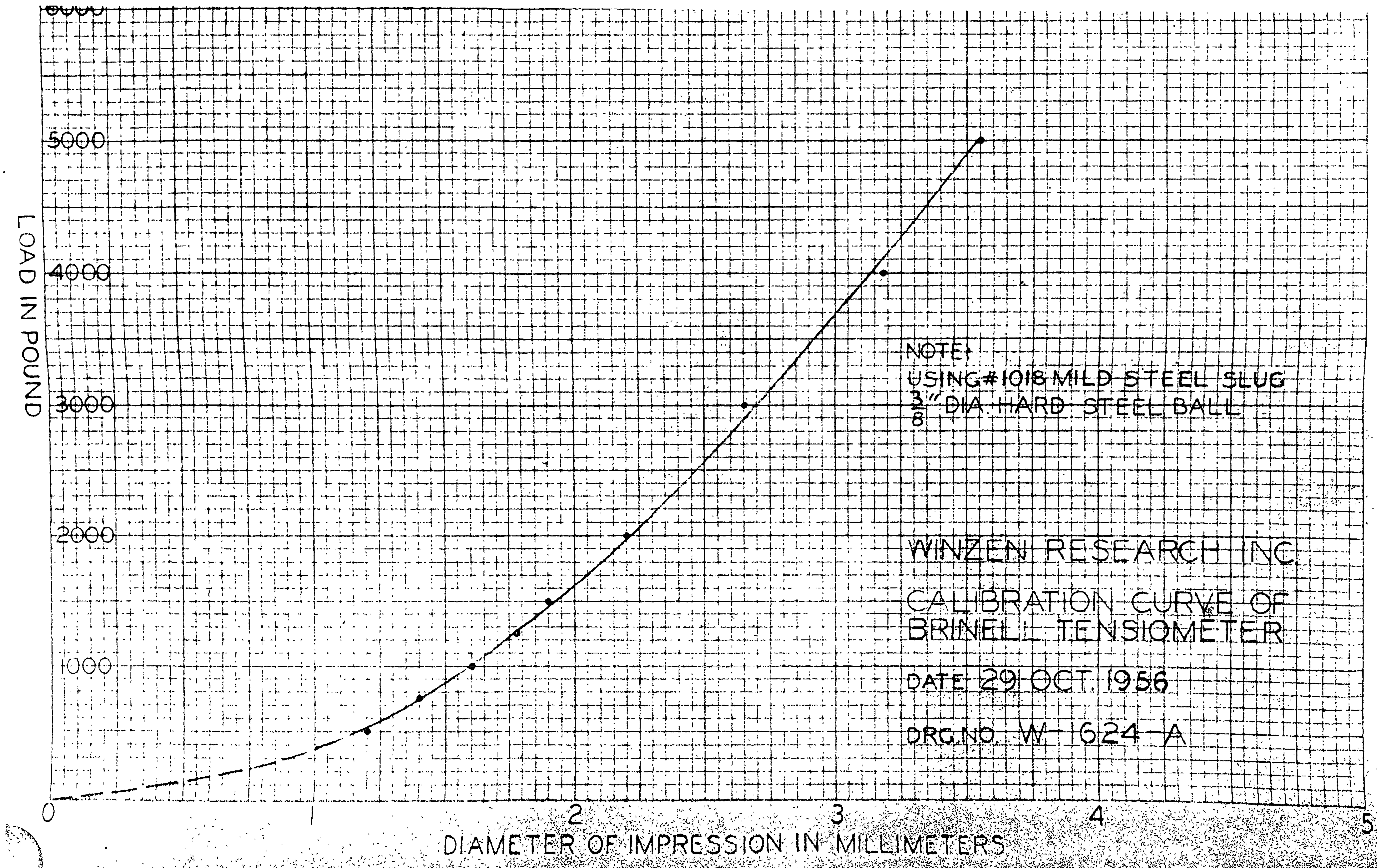
Twin City Testing and Engineering Laboratory, Inc.

By______________________________

and Unit No. 422 started at 0mm gradually building up to 0.202mm. According to the calibration curve, both of these units were under a tension of 0 lbs. initially building up to 75 lbs. Considering that there were six shroud lines and a payload of 796 lbs., this tension of 75 lbs. would be equivalent to 0.57g maximum. However, unit No. 422 recorded while its drum was stationary, a vertical line 0.765mm long. This is equivalent to a force of 325 lbs. or 2.45g. This corresponds with the findings from the Brinell tensiometer. The calibration curve for the Brinell tensiometers will be found on Drawing W-1624-A. Two of these units were likewise used, installed in diametrically opposite shroud lines at 60° to the Exline tensiometers. The diameter of the dimple on unit "A" was 0.7 mm and on unit "B", 0.9 mm. Thus, unit "B" recorded a tension of 325 lbs. which is identical with that recorded on Exline unit 422 and equal to 2.45g.

Although the Cedar Engineering accelerometer unit indicated the nature of the acceleration it proved far too difficult to read to any degree of accuracy. Rather than photograph the electronic eye-tube at 16 frames per second some means should be devised to continuously record on a strip of film. With the present set-up, the time interval between frames is too great and also the distance between the camera and the eye is of necessity large, resulting in a blurred image during a shock.



NOTE:
USING #1018 MILD STEEL SLUG
$\frac{3}{8}$" DIA HARD STEEL BALL

WINZEN RESEARCH INC.

CALIBRATION CURVE OF
BRINELL TENSIOMETER

DATE 29 OCT. 1956

DRG. NO. W-1624-A

It is significant that both the Exline and Brinell Tensiometers recorded the maximum of 2.45g.

The camera package which recorded the parachute opening is the large package mounted on the side of the gondola as shown in Photo 749-41.

° Capsule Atmosphere

Provisions had been made to telemeter several temperature measurements which would have provided a wealth of information concerning atmosphere temperature and humidity control, the conditions of the related equipment, and relative surface temperatures between single and double paned windows. Unfortunately, a short circuit caused the telemetering transmitter to emit a steady signal during most of the flight clearing only a part of the information channels for about 4 hours of information. Only the altitude, interior pressure and inside temperature were obtained. Inside temperature was obtained from an experimental temperature transducer which was carried as a hitch-hike on this flight and mounted inside the telemetering package. This was actually a modification of the inside pressure transducer as it utilized the same code drum.

Other means of recording included a clock operated smoked disc for recording interior pressure and a 35mm camera to record the relative weight of the oxygen contained in the liquid oxygen converter and the oxygen partial pressure. The telemetering equipment, a block diagram of which is shown in Drawing W-1266-A, was tightly enclosed with a clear polyethylene cover to reduce the possibility of animal wastes affecting the devices. A small ventilating opening was provided near the top of one side, and other small openings were provided as required for connecting wire cables. The interior pressure bellows and bimetal temperature sensing device (experimental unit) were mounted on the first shelf above the bottom of the telemetering equipment rack.

The data gained from these various instruments during the flight is plotted on Drawing 383,315.

1. Oxygen Converter

The same oxygen converter was used on Flight 749 as was used on the previous Flight 747. This system was designed to function when the cabin pressure was reduced to 5.6 psi. As will be noted from the cabin pressure curve on Drawing 383,315, after passing 18,000 feet, the capsule is automatically depressurized to a total inside pressure of 7.5 psi or approximately 500 mb by means of a relief valve. However, the oxygen system has a 160cc per hour inboard bleed which would tend to replenish the oxygen consumed by the animals. Not until the animals had consumed oxygen over and above this 160cc per hour rate to decrease the pressure to 5.6 psi would the oxygen converter begin operating.

For these reasons, the relatively flat curve between 0900 and 1300 CST with respect to the capsule pressure can be interpreted to mean that the mice were consuming very little more than 160cc per hour. The relatively sharp rise between 1400 and 1530 CST suggests that the animals had significantly increased their activity level. Colonies of mice and guinea pigs, especially mice are known to have alternate periods of activity and inactivity, particularly during the daytime when they are naturally asleep. This sharp rise would then be a period of greater activity.

In order to allow for pre-flight preparations and the time required to reach an altitude where the gondola pressure will be reduced to the point where the oxygen converter functions, the capsule atmosphere was enriched with oxygen after it was sealed. It is to be noted that the capsule with the external air regeneration system has a volume of approximately 50.25 cubic feet. If it were filled with 100 percent oxygen under a standard condition, it would contain 4.49 lbs. of oxygen. However, the oxygen content was enriched only to 46.8 percent, therefore, it contained only 2.1 lbs.

or 965 grams of oxygen. However, as the balloon ascended to ceiling, the sniffle valve dumped half the atmosphere overboard, so only 483 grams of oxygen would have remained. This would have been sufficient for 7.35 hours at a consumption rate of 65 grams per hour if entirely used. The bleed rate of 160cc per hour would be equivalent to 0.229 grams per hour - considerably less than the 65 grams per hour required. This does not account for the quantities released by the pressure relief valve due to pressure build-up in the liquid oxygen converter due to thermal gain.

The camera which was to record the capsule oxygen partial pressure and the quantity of oxygen used, failed shortly after the capsule was sealed due to a short circuit on its batteries. According to the cabin pressure curve, the critical operating pressure of the oxygen system was just being approached at the time of cut-down.

2. External Air Regeneration Unit

The air regeneration unit used on this flight was similar to the unit used on Flight 747 except that it was mounted external to the capsule. A schematic of the external unit will be found on Drawing 383,312. Although the air regeneration unit is located at the bottom of the capsule, the capsule undercarriage absorbed the landing shock very well and physical damage to the air regeneration unit was quite limited. (See Photos W-2151, W-2155 and W-2156).

a. Physical appearance after landing shock

Chemical tank:

1. Slight dent (2" dia. x ½" deep) in upper part of 6" tube near tank.
2. Slight scratch 1/16 x 2" on tank wall 6" above dent in tube.

Chemical Blower:

1. Few (6 to 10) droplets LiCl solution in blower housing.

Chemical square to round transition:

1. Pushed up from bottom - broad dent 1" deep.
2. Buckling (and 1" long crack on one corner) on upper corners at tee.

   Note: This section was intended as a fail section.

Tee:

1. No damage on bottom from ground impact.
2. Divider fin on discharge side slightly bent and torn from divider inside capsule.
3. Much mouse droppings - especially in intake section.

Cooler Blower housing - no apparent damage.

Cooler Transition housing:

1. Slight dent in one end of condensate tank 2" diameter x ½" deep.
2. (Informed that about 2 oz. condensate removed)

Heat exchanger - no damage other than dirt from dragging.

Capsule shell:

1. Force on air regeneration unit upon collapse of undercarriage forced connecting ring into lower hemisphere about 2".
2. The inside divider plate caused a 1" deep bulge on one side of the lower hemisphere where the hemisphere had been restrained from being pushed in.

Chemical Air tube:

1. Upper one foot and lower three feet of flexible tubing stained with urine.
2. Mouse droppings in upper and lower portions of tubing.

b. Analysis of Chemical System Performance

The operating arrangement of the chemical system was changed somewhat from the previous animal Flight 747. This was necessary in part to provide additional space in the capsule and also to improve performance. The chemical system was relocated from the inside of the capsule and attached to the outside of the capsule. Only one chemical tank was used having twice the diameter of the previous chemical tanks. This reduced the velocity of air flow by the chemicals to approximately one fourth that occurring in the previous arrangement. The diameter of the thirty porous cloth chemical bags was doubled to two inches. Rather than filling a bag with only one chemical, a proportionate amount of all the chemicals were placed in the bags in layers in the proper order.

For this flight, the air first passed by a predrier of lithium chloride (4500 grams) to remove the bulk of the moisture contained in the atmosphere. The next layer passed by the air consisted of 3750 grams porous lithium hydroxide for carbon dioxide removal. One of the products of the reaction of carbon dioxide with lithium hydroxide is moisture. The final chemical layer consisting of 4500 grams magnesium perchlorate was added to reduce the humidity of the treated air discharged into capsule because the atmosphere humidity of the previous flight was believed excessive.

No data was obtained concerning the humidity, carbon dioxide concentration, or oxygen partial pressure. It is known, however, that prior to launch, the oxygen partial pressure was approximately 450 mb.

At the time the recovery crew reached the capsule about an hour after landing, the interior temperature was about 84° F. The blowers were not operating after landing, one lead for the 24 volt battery was torn loose. The outside air temperature was approximately 40° F. Little condensation was noted on the window surfaces. The temperature of the inside surface of the window must have been at approximately the dew point of the inside air at 84° F. At the design rate of moisture gain to the capsule atmosphere, the humidity would reach saturation beginning from zero within sixteen minutes with the blowers off. Considering the probable activity of the mice following the landing, possibly three times as much time might elapse before saturation is reached.

Assuming an introduction of .130 lbs. carbon dioxide per hour having a density of 0.1115 lbs/ft_3 at 84° F and standard pressure, the capsule carbon dioxide concentration would reach one percent in 24 minutes assuming zero concentration at the start, and the blowers not operating. The Minnesota Department of Health states that some discomfort is noted in concentrations as low as one-half of one percent, and that the human body can tolerate conditions as high as ten percent briefly. They stated that the effect of carbon dioxide is to stimulate the nerve center of the brain governing the breathing rate, and the gas is not poisonous but reduces the oxygen supply as a result of its concentration.

The total weight gain of the chemicals was 1183.2 grams. Major Simons estimated 4 to 5 ounces of condensate in the cooler whereas the airmen report $1\frac{1}{2}$ ounces were measured later on. Assuming the latter figure, to derive the poorest performance picture, the total gain from carbon dioxide and moisture would be approximately 1230 grams.

On Flight 747, the moisture accounted for $\frac{663.4}{1021.7}$ of the total weight gain and the carbon dioxide reaction accounted for the balance of the weight gain. Therefore, assuming the same proportions, weight gain due to moisture absorption would be $\frac{633.4}{1021.7} \times 1230 \approx 762$ grams, and the balance, 468 grams, a result of the carbon dioxide reaction. The actual weight of carbon dioxide absorbed is approximately $\frac{44}{26}$ of the observed weight gain of lithium hydroxide (approximately 468 grams), or 792 grams. The capsule was closed approximately fifteen hours. Therefore the approximate rate of moisture absorption was 50.75 grams per hour or

.111 lbs. per hour. The rate of carbon dioxide absorption was 52.8 grams per hour or .116 lbs. per hour.

Two samples of lithium hydroxide were taken from a bag numbered "26" which was located in line with the inlet about midway between the center and the outer shell. One of these samples was taken from the periphery and the other from the center to determine the degree of utilization. The results of this analysis are not yet available.

c. Heat Exchanger Performance

The heat exchanger cores were fitted with four 9" x 9" x 4" water pans intended to be filled with water to a depth of three inches. The total water capacity at this level is approximately thirty-five lbs. The actual water contained in those tanks immediately after launch, allowing for some spillage was probably not less than twenty lbs. Dry ice was used to cool the water prior to launc

It is noted on the smoked disc record of cooler blower operation that the thermostat calle for cooling from 0715 to 0718 at the launch site, stopping at the time of launch, and then calling for cooling again at 0724 through 0737. Cooling was not called for again until 1024 and the blower evidently remained running during the remainder of the flight.

Because the only telemetered temperature data was a roughly calibrated experimental bimetal thermometer located in the polyethylene covered telemetering equipment rack, the temperature data is of little value unless all factors affecting it are considered - and then only as a relative indication.

The boiling point of the water at ceiling (103,000 feet) would be approximately 42° F, and the temperature of the cooled air would then be approximately 45° F. During the time shortly after the blower turned on at 1024, the heat exchanger appeared to have more than adequate cooling capacity. Although the thermostat (located under the air discharge from the animal cages and above the telemetering equipment) was set to turn on the blower at 70° F, the telemetered temperature was about 65° F and rising about 8°F per hour. The telemetered temperature peaked at 69.5° F at 1120 and began dropping to a low of 68° F at 1218. About 1240, the temperature began to rise again, reaching a peak rat of rise of about 6° F per hour at the time of th last data. However, three factors were affectin the heat exchange capacity during the last peri

1. The altitude of the balloon was droppin raising the boiling point of the water

from 42° F at 103,000 feet to 47° F at 99,600 feet.

2. The water level was rapidly diminishing causing a loss of effective cooling area.
3. It is believed that the activity of the animals increased considerably during this period as evidenced by an increase in the rate of capsule pressure drop. This was probably caused by an increase in oxygen consumption rate above the initial charge, and the oxygen regulator bleed rate.
4. It is possible that the increase in temperature of the capsule was in part due to a greater portion of the capsule being exposed to the sun's radiation in the later afternoon. The capsule did not hang in the shadow of the balloon at any time.

When the capsule was recovered, approximately one half inch of ice was formed in the bottom of the water pans, and a partial ring of ice found around the side of water pans. Because ice cakes were formed on the bottom of the pan, it is likely little or no water was lost upon landing. The approximate weight of this quantity of ice would be between six and eight lbs. Therefore, approximately twelve to fourteen lbs. of water was evaporated in cooling over a period of 7½ hours. The rate of removal of heat, assuming twelve lbs. evaporated, would be 1705 BTU/hr., six percent higher than the rated capacity of 1600 BTU/hr. If it were assumed that 14 lbs. of water were evaporated, the cooling capacity would have been 1990 BTU/hr.

The partial ring of ice, ¼" thick, around the edges of the pan was probably due to surface freezing during the ascent, which had not melted during the day. It is to be noted that some dry ice was still present in the water tanks during the launch period. This is more likely to occur on the edges opposite the heat exchanger cores because of the low convection rate of water at those temperatures. It is believed that the water would never freeze too deeply during ascent because the initial water temperature is higher at launch, and a greater quantity of water is available as a heat source.

VI. CONCLUSIONS

1. The chemical system as used appears satisfactory will be confirmed by an additional exhaustion te the ground.

2. The heat exchanger exceeds design capacity on th of water evapcration.

3. It is doubtful that the liquid oxygen converter oxygen to the animals at any time during this fl than the 160cc/hr. from the inboard bleed from t valve and possibly occasional discharges of oxyg the pressure relief valve.

4. Tangible evidence of the phenomena associated wi parachute drops has been gained to justify the l blished use of parachutes in this manner in conn with balloon flights. A second flight is antic to collect data in this regard.

5. In view of the results of this flight and previo the undercarriage as designed is considered sati

WINZEN RESEARCH INC.
8401 LYNDALE AVE. SO.
MINNEAPOLIS, MINNESOTA

BALLOON FLIGHT REPORT

Flight No. 749 Date: 14 April 1957 Time: 0718C

Project No.: AF-383 Flight For: Aero Med (Major Simons)

Scientific Payload: Animal gondola Weight: 735#

Scientific Purpose: High altitude animal exposure, parachute release data, gondola air conditioning test.

Scientific Success: Very good

BALLOON DATA

Manufacturer: WINZEN RESEARCH INC. Size: 200.2' x .0015" Serial No.: 200-150-V-9

Type: "FIST" construction, bicornuate ducts (high), 250# load bands, base ring for parachute suspension(24 gores of .0 material) Weight: 1046#

LAUNCHING DATA

Launching Site: Fleming Field, So. St. Paul, Minn. Launching Method: Roller Platform

Wind: N 5 Sky: Clear Temperature 28

Total Payload: 863 # Free Lift 10½% 224 # Gross Inflation: 213

FLIGHT DATA

Max. Altitude: 103,500 ' Theoretical Altitude: 107,000

Flight Duration: 10 hours 27 minutes Altitude Maintenance: Good

Ballast: None Rate of Ascent: 560 fpm

Landing Site: Saginaw, Michigan Recovery Time: Immediately

Balloon Performance: Excellent Balloon Landing Site Near load

FLIGHT RESUME

Excellent launch - Very good flight. For details see formal flight report.